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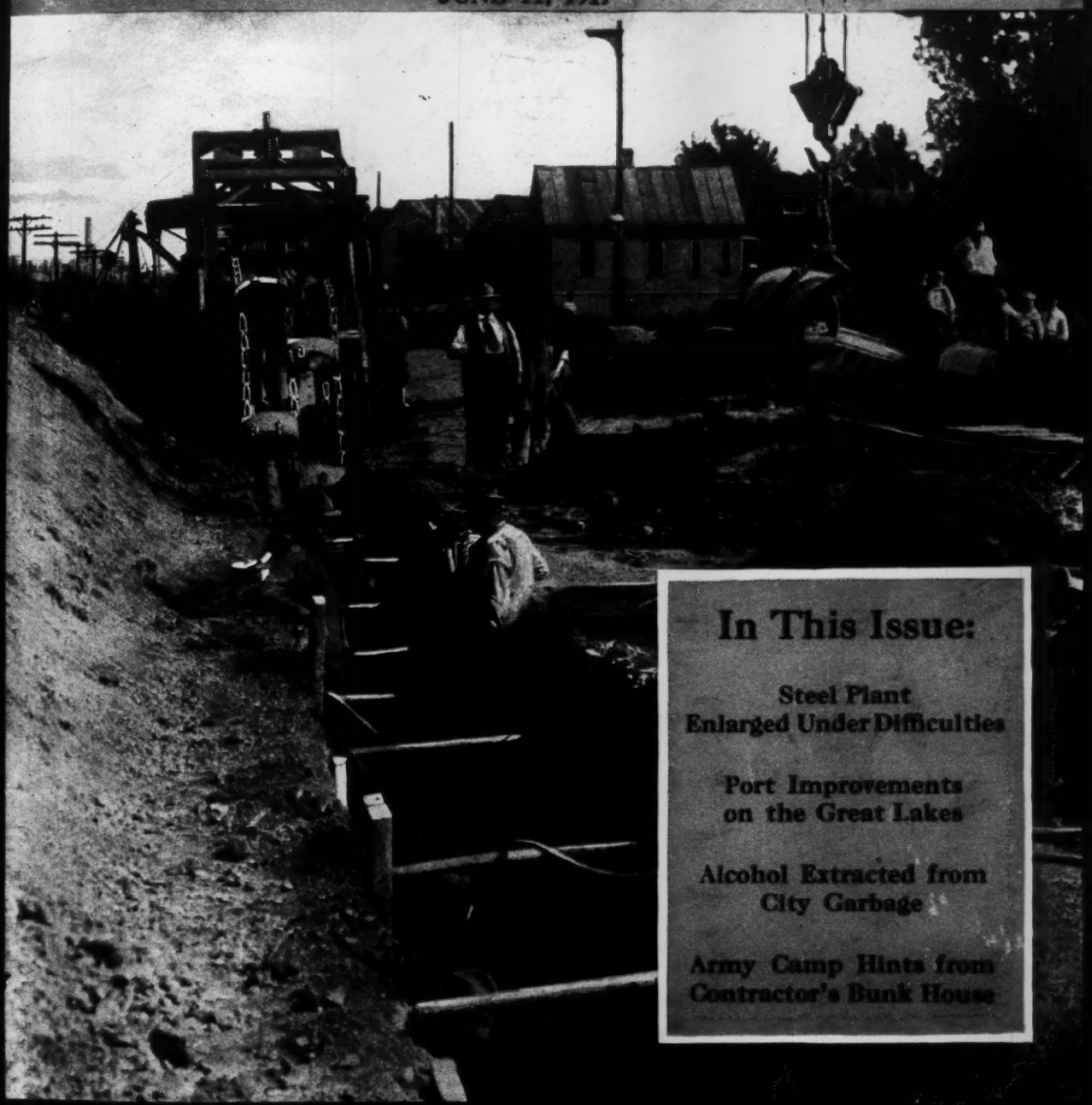
JUN 14 1917

JUNE 14, 1917



In This Issue:

Steel Plant Enlarged Under Difficulties

Port Improvements on the Great Lakes

Alcohol Extracted from City Garbage

Army Camp Hints from Contractor's Bunk House

Contractor's Plant Replaces Men—Few Laborers Required on Job When Trench Excavation, Pipe Handling and Caulking are Done by Machinery

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A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MC GRAW-HILL PUBLISHING COMPANY, INC.

Volume 78 NEW YORK, THURSDAY, JUNE 14, 1917 Number 11

DERRICK BOATS CONCRETE NAVIGABLE PASS FOUNDATION IN ALTERNATE SECTIONS—CRIBS AT RIGHT

Concrete Lock Paving Done First in Rapid Construction of Ohio River Dam 35

Track Ties, Laid Afloat, Land in Place as Coffer Is Pumped—Despite Extra Work, Longest Dam on River Is Finished in 398 "Fair Working Days"

By GEORGE W. McALPIN

United States Junior Engineer, Dam 39, Florence, Ind.

ALTHOUGH Government Dam 35 on the Ohio River is the largest yet completed on that river and although two cofferdams across the main channel were required for work under supplemental agreements, the contractor for this dam finished it in three seasons, between Dec. 29, 1913, and Dec. 31, 1916, about 19 months ahead of contract time. During this period, because of winter weather or floods, but 398 "fair working days" were recorded by the Government.

Work Remarkable in Several Respects

The dam is on piles, and the rapid progress made was due to providing plenty of plant to drive the piles and handle the concrete work and to several other methods of hastening the construction. Everything was got ready before pumping was started, even to floating ties for the traveler tracks, spaced with strips, so they would ground in place for use. The lock travelers were rapidly assembled under a short cableway across the lock cofferdam at its center. The lock paving was started first and carried along with the piledriving. A new way of driving piles with derrick boats was employed in the river sections, and cofferdam and esplanade fill was sluiced to place by the discharge from a pump boat.

With these methods, although the first cofferdam was not pumped until July 4, 1914, the lock, both guide walls and the abutment on the opposite shore were entirely completed during the first season. It is believed that the estimate of $120,000 for work done in August of this year is still a record monthly estimate for these dams. The total value of the work completed in the 398 days mentioned was $1,270,000, which included two extra river coffers.

The contract for this dam was approved Nov. 25, 1913, and the first work done at the site was the erection of a camp and the construction of sidings on the

PUMP BOAT WASHES FILL TO PLACE

Chesapeake & Ohio Ry., followed by the assembly of materials and plant. It was not until May 25, however, that work could be started on a 20-ft. cofferdam to inclose the lock. This coffer was of the ordinary box type, its top about 18 ft. above low water and having a concrete decking 6 in. thick to preserve it in case of floods. A dredge and two derrick boats were kept busy excavating along the line of the lock walls. The excavated material, mostly sand and gravel, was used as cofferdam filling. The coffer was closed and pumped out on July 4, 1914.

The pumping plant, probably the largest of its kind on the Ohio River, was mounted on a boat 36 x 80 ft., which was allowed to settle on a capped pile foundation as pumping proceeded. The equipment included four 15-in. rope-driven centrifugal pumps with 18-in. suctions. Steam was supplied by a battery of three 150-hp. marine boilers. The boat also mounted an air compressor and a complete electric-lighting plant capable of illuminating the entire job at night.

Plant Assembled Under Cableway

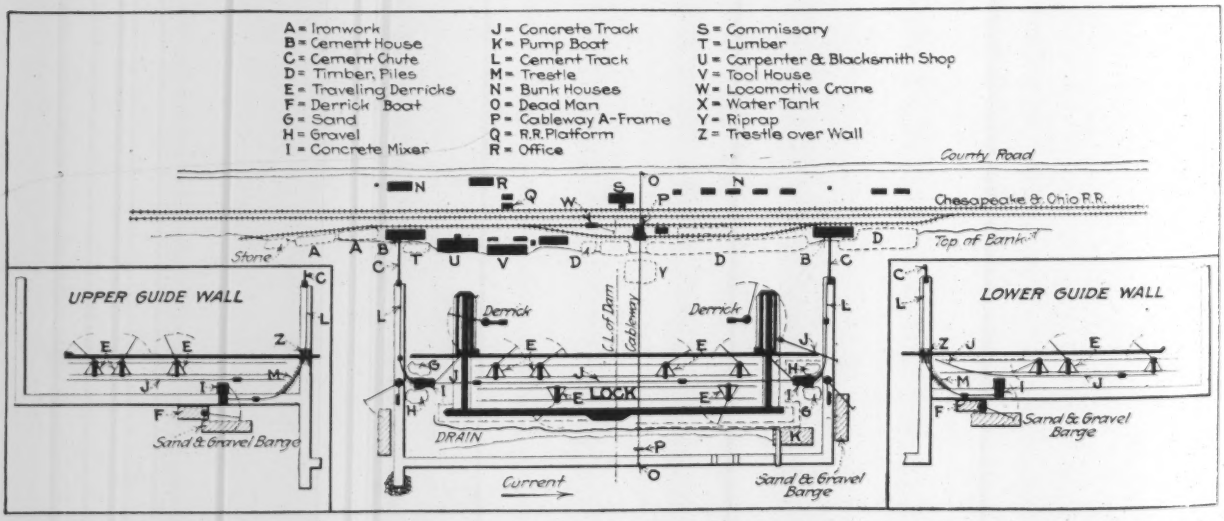
As the water inside the cofferdam fell, ties for the traveling-derrick tracks, previously rafted and spaced with small strips, settled to place. Round piling and sheet piles in small rafts were also allowed to settle in convenient places. So carefully had the excavation been done in the wet that, when the cofferdam was pumped dry, it was found that very little grading was needed before beginning work.

The plant was immediately assembled inside the cofferdam by a cableway running from the top of the bank to the outer arm. Six traveling derricks, running upon 25-ft. gage tracks parallel to the walls, were set up in succession. Each carried a 60-ft. boom and was operated with a double-drum hoist. Two of them were used to drive the round piles supporting the lock walls, while two land piledrivers, on rollers, were used to drive the 10-in. tongue-and-groove sheeting required to project the foundation of the walls on the outside. All four of these drivers worked three 8-hour shifts a day.

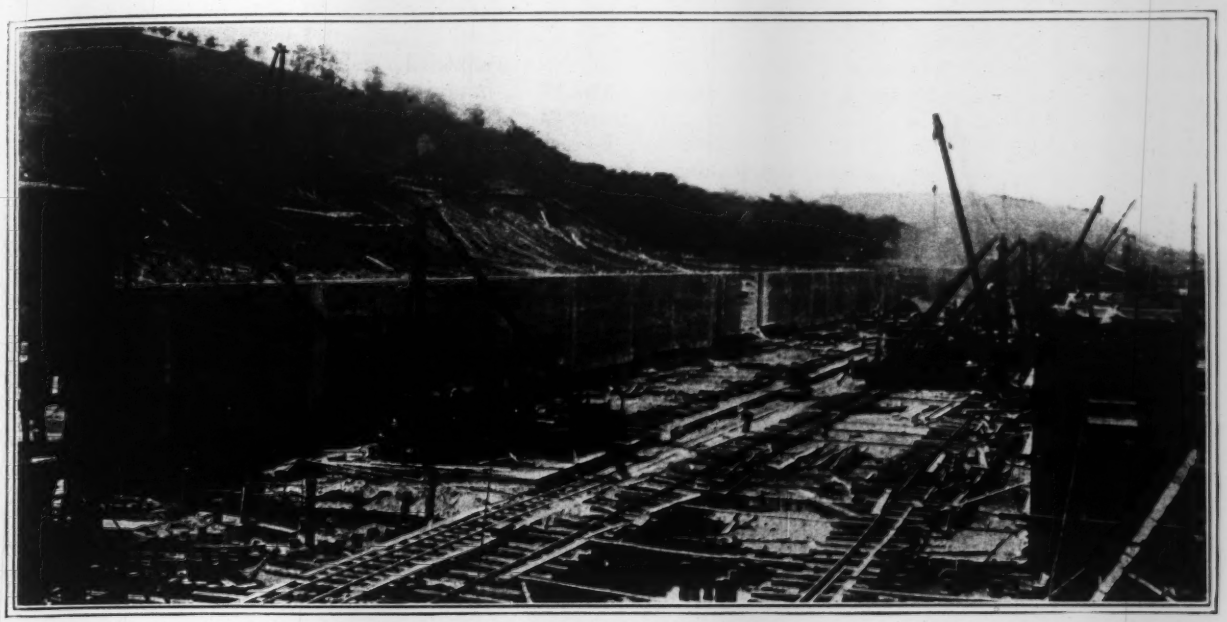
Lock Paving Concreted First

All six of the travelers were at first set up facing the land wall. The first two assembled were started driving round piles after they had been moved just sufficiently to permit erecting the next pair. The piledriving leads and hammers were, however, quickly moved to the next two travelers as soon as these were ready, while the first pair took up the work of concreting the lock floor, beginning with the half next the land wall. Concreting was carried in both directions toward the ends of the lock.

This pair of travelers backed away from the work until they reached the extreme ends, after which they were run back on the finished floor and completed the remaining portion. The second pair of travelers driving piles started on tracks laid on the ground, but were run upon the concrete floor as soon as they reached it. The two remaining travelers, when assembled, finished concreting the portion of the floor left out at the center of the lock.



WITH THIS PLANT LAYOUT, LOCK AND BOTH GUIDE WALLS WERE FINISHED IN LATTER HALF OF ONE SEASON



LOCK PAVING, CONCRETED FIRST, FURNISHED SOLID BASE FOR TRAVELER TRACKS AND LESSENED CLEANING UP

and a 10-ft. strip next the land wall, which was omitted until the wall had been completed. The first pair of travelers meanwhile had been turned to face the river wall and completed the other half of the lock floor before piledriving for that wall began. A 10-ft. strip down the center of the lock chamber was the last to be finished. This had been left to provide a clear space for the cars carrying concrete.

Two Concrete Plants Employed

A mixing plant was set up at each end of the lock cofferdam. Sand and gravel were dug from the river bed, washed and screened by a digger belonging to the contractor. The material was delivered on barges and loaded into a hopper over each mixer by derricks placed on the cofferdam. The mixers discharged into concrete buckets set upon cars that ran on a narrow-gage track down the center of the lock. The cars were operated by cable and haulage engines. The buckets were dumped into forms by the traveling derricks.

All the wall forms were made in sections, permitting rapid and easy erection and movement. The sections were handled by the travelers. Concreting was carried on simultaneously in two wall forms at a time by the two mixing plants, 10,000 yd. being placed in this way during the month of August, 1914.

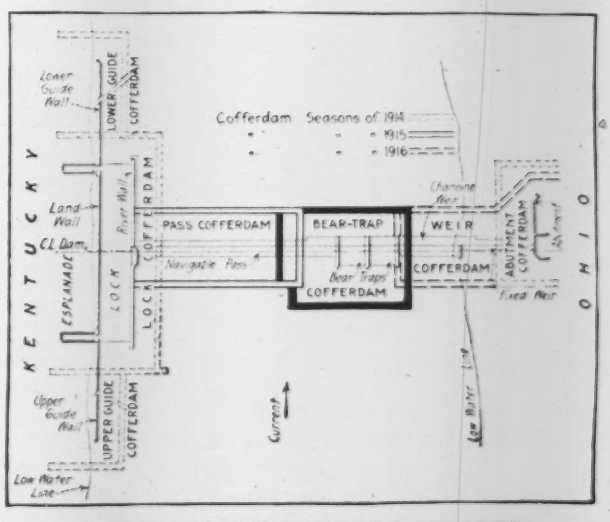
The recesses for the sliding gates were built by derricks set on the bank behind the land wall. One of these derricks, with an 80-ft. boom, was so placed at each recess as to reach the extreme ends. Excavated material was thrown directly behind the land wall as fill. A short track from the concrete mixer carried cars to positions reached by these derricks.

Guide Walls Drained Into Lock Cofferdam

Such progress was made on the lock that it was decided to start the two guide walls in September, 1914. Cofferdams inclosing them were constructed and the upper and lower arms of the lock coffer cut through, draining the new dams without changing the position of the pump boat. The plant released in the lock was moved to the other coffers. A total of 4173 yd. of concrete was placed in the upper guide wall in 17 days, while 3363 yd. was placed in the lower guide wall in 12 days. The river continuing at a favorable stage, the abutment, on the Ohio side opposite the lock, was begun and completed during November of the same season, although rapid work was hindered to some extent by cold weather. With the completion of this work, the cofferdams were removed by derrick boats and the plant was laid up for the winter.

Fill Washed Into Place by Pump Boat

Before the river fell the following spring to a stage permitting cofferdam work, the fill for the esplanade was



DAM IS LONGEST YET BUILT ON RIVER

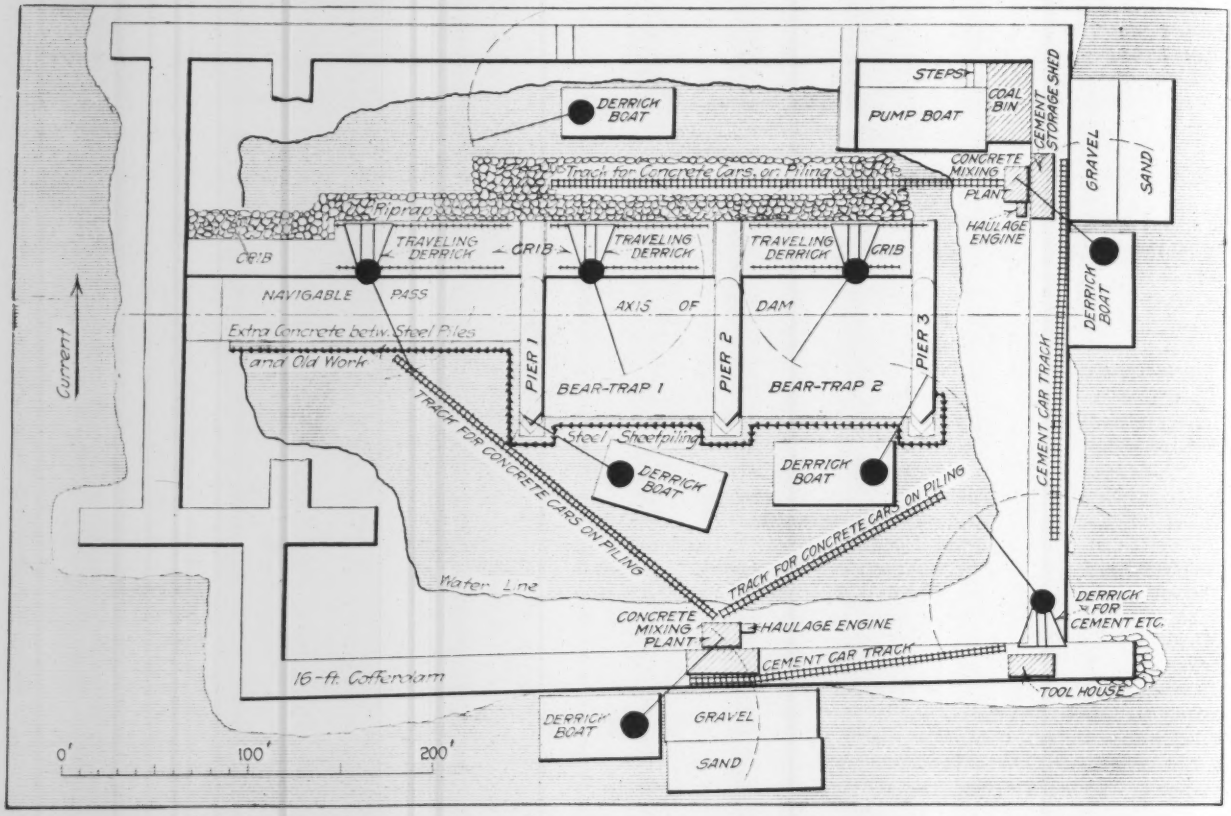
placed behind the land wall. Material was scowed into the lock chamber and thrown behind the wall in piles by derrick boats. It was then washed into place by a stream from the pump-boat discharge. This fill packed well and showed practically no settlement after 18 months' time.

The foundation for the navigable pass, 700 ft. long at this dam, was next inclosed. This concrete foundation on round piles is protected by a row of sheet piles upstream and by cribs and riprap downstream. Upon this concrete foundation is carried the movable dam of the Chanoine wicket type. Practically all the excavation for the foundation and cribs was done by derrick boats during the construction of the cofferdam. The cribs, of 10 x 12-in. timbers, 14 ft. deep and 20 to 30 ft. wide, were built in convenient sections, floated to place between guide piles previously driven, and sunk to position by weighting them with large stone.

Riprap Placed Under Water

Gage boards on the sides and ends of the crib sections made it possible to sink them accurately to depth. As soon as this had been done, barges loaded with one- and two-man stone for filling the cribs were moored directly over them, and the stone was dumped off into the water. Although this method frequently resulted in forming piles of stone on top of the cribs instead of filling the pockets, making it necessary to rehandle some of the stone after the cofferdam was pumped out, it proved the cheapest way of handling. The large riprap stone below the cribs was also placed directly before the cofferdam was pumped out. After unwatering, the stone filling was completed, and the cribs were decked with 10 x 12-in. hardwood.

Most of the work in the pass cofferdam was carried on by derrick boats floated in a channel excavated just above the line of the foundation. These boats were assisted to some extent in placing stone by travelers set on the cribs. The round piling for the foundation was driven with swinging leads by the derrick boats, using the novel and highly efficient rig described on p. 25 of the *Engineering Record* for July 1, 1916. On one occasion 53 round piles were driven in one 8-hour shift by one boat with this rig.



TWO CONCRETE PLANTS FINISHED BEAR TRAPS QUICKLY AT CLOSE OF SECOND SEASON

The mixing plant in this coffer was identical with those used in the lock. The track for concrete cars, however, was carried on piles and the concrete placed by the derrick boats.

Immediately upon the completion of the pass, work was started on the bear traps, 91 ft. long, both of which between three piers, were inclosed in the next cofferdam. Each trap is composed of a lower steel leaf hinged at its downstream edge and an upper timber leaf hinged at its upstream edge. The upper leaf laps the lower, which is hollow, and is raised by the flotation of the latter when water from the upper pool is admitted to the space beneath the leaves. The steelwork for these leaves, which weighs about 500 tons, was erected, tested and painted inside of 35 days after the completion of the piers and foundations.

On account of its extra length, 1527 ft. from land wall to abutment, even though the navigable pass section was made the maximum desirable length of 700 ft., it was found advisable in the design to include a fixed weir section 255 ft. long next the abutment, in order to cut the Chanoine weir section down to a workable length. This is the first dam the foundation for which has been completed to contain such a fixed weir. It is a solid gravity dam, the upstream face being vertical and the downstream side being curved to receive the overflow. Its top is at the elevation of the upper pool. A fourth river pier, similar to the bear-trap piers, but smaller, separates the fixed from the Chanoine weir. Both these weirs were completed during 1916. In addition, a row of steel sheeting was driven along the upstream side of the pass, which required two extra cofferdams across the main channel.

Steel Sheeting Required Above Dam

During the construction of the bear traps it was decided to drive interlocking steel piling along the upstream side of this and the weir sections. This work, estimated at $53,000, was carried out in the cofferdams built for constructing these foundations. However, when it was decided to extend this steel sheeting along the upstream side of the navigable pass at a cost of $62,000, it was necessary to build additional cofferdams and unwater part of the area a second time. In order to maintain an open channel, two dams were required, and it was stipulated that one should be removed before the other was begun. The lower arms of the coffers were built directly on the pass foundation, the upper arms being placed on the river bed. This construction brought the lower arms so close to the work that derrick boats outside the coffer were able to reach over and handle the driving in addition to placing the extra seal of concrete 5 ft. wide required between the steel sheeting and the old foundation. This work, completed with the weir sections, made the last season a busy one.

Esplanade Paved in Three Strips

The esplanade paving, the last large item of work, was carried out at the same time. Six inches thick, this paving is 600 ft. long by 156 ft. wide. It was carried through in three strips, 52 ft. wide, running parallel to the land wall of the lock. A traveler on a track laid on the ground first concreted the strip farthest from the land wall. It was then turned around and concreted the strip next the wall. After this it was moved back upon the first strip and completed the intervening space. The mixing plant, supplied of course by water, was set on the center line of the esplanade nearer the land wall. Tracks radiating from the mixer carried the concrete buckets on cars to the traveler. The paving was divided into 4-ft. square blocks. Alternate 4-ft. rows were concreted each day. The division of blocks in the rows was made by 6-in. plates 4 ft. long. These, when oiled, were easily removed as the concrete set.

Although the season of 1914 may have been an exceptional one, which may account to some extent for the unusual progress made, the excellent organization of the contracting company deserves credit for the rapid construction. This firm, the National Contract Co., of Evansville, Ind., by skillful layout of plant, unstinted use of equipment and the adequate and timely supply of materials, has been able to make an enviable record. The work was done under the direct supervision of Government engineers, Maj. Robert R. Ralston being the present district engineer officer. The contractor's organization was conspicuous for the few men it employed and the amount of work each was capable of attending to. J. C. Thomas in 1914 and 1915 and C. W. Maxon in 1916 have acted as superintendent, while E. P. May has been in charge of the office work.

Committee Defines Some Terms Used in Fire Protection

Besides bringing to the attention of the engineer the fine, precise word "orismology" the committee on nomenclature of the National Fire Protection Association presented to the recent annual meeting of the association several definitions which are worth wider circulation. "Orismology" appears in the preface of the report just as though the committee were in the habit of using the word in daily converse. It means—according to a hastily consulted dictionary—"the art or practice of defining scientific or technical terms," which should qualify it for admission in engineering circles. The definitions—admittedly suited more to fire-protection terminology than to general use—are partly as follows:

Fireproof—The use of the term "Fireproof" is recommended to be discontinued. This general term has been erroneously applied to buildings and materials of a more or less fire-resistive or incombustible nature. Its indiscriminate use has produced much misunderstanding, and has often engendered a feeling of security entirely unwarranted.

Fire-Resistive—The term "Fire-resistive" applies to materials and constructions which will satisfactorily resist fire in accordance with the specification established by the Joint Conference on Fire Tests.

Incombustible—The term "Incombustible" applies to materials and constructions which will not ignite when subjected to ordinary fire. Alternative Definition—The term "Incombustible" applies to articles, goods, wares, merchandise or materials of construction which will not burn or support combustion. Articles, goods, wares, merchandise or materials of construction shall be held to be "incombustible" when the individual units comprising the finished product do not contain combustible material in sufficient quantity to procure such a simultaneous or destructive combustion of these units as would constitute a menace to life, limb or property by fire.

Noninflammable—The term "Noninflammable" applies to materials and constructions which will ignite but will not support flame when subjected to ordinary fire. Alternative Definition—The term "Noninflammable" applies to articles, goods, wares, merchandise or materials of construction which will support combustion, but will not readily burn. Articles, goods, wares, merchandise or materials of construction shall be held to be "noninflammable" when the individual units comprising the finished product do not contain inflammable material in sufficient quantity to procure a "flash" fire such as would constitute a menace to life, limb or property; or where the finished product is so wrapped, packed, bundled or wound on cores that its inflammable quality is substantially nullified.

No Taste from Creosoted Wood-Stave Pipe

Water was recently turned into a 63-in. creosoted wood-stave pipe line supplying the Wenatchee reclamation district. Reports state that it did not take up any taste from the oil in the staves after a 72-hour test. Another point in the use of creosoted staves is that they can be cinched tight when the pipe is laid, no allowance being made for subsequent swelling, as is necessary with untreated staves. Few treated wood-stave lines have been laid, although the use of treated timber flumes has long been practiced.

Extracting Alcohol from Garbage Would Conserve Vast Quantities of Grain and Potatoes

Experiments at Columbus Garbage-Reduction Works Promise Large Profits from Alcohol with Little Effect on Grease and Tankage—Alcohol Profit Estimated at $1.34 per Ton of Garbage —$29,260 Normal Operating Cost for Plant To Treat 20,000 Tons Annually

CONSERVING the food supply of the country by turning city garbage into alcohol instead of using grain or potatoes for the purpose is a promising possibility established by carefully conducted experiments just reported from the garbage-reduction plant of Columbus, Ohio. The experiments show that one ton of Columbus green garbage will yield 4.8 gal. of 95% alcohol of satisfactory quality. Estimates indicate that a $36,000 plant would produce from the 20,000 tons of garbage treated annually at the reduction works a total of 96,000 gal. of alcohol, giving a profit of 42c. per gal. at war-time prices or 30.5c. under normal conditions. A year's garbage, the tests indicate, would yield as much alcohol as could be produced from 33,600 bu. of shelled corn, 39,529 bu. of wheat or 110,344 bu. of potatoes.

Over a Year of Experimentation

Such are the main conclusions drawn after more than a year of experimentation at Columbus with the alcohol-from-garbage process covered by United States Patent No. 1,111,017, granted to Dr. J. J. Morgan, 29 East Madison St., Chicago, Ill. In essence, the process consists of extracting grease from garbage by cooking with sulphuric acid and steam, thereby converting the starch and allied products to dextrose; separating the grease from the tank liquor; neutralizing the acid sufficiently to allow fermentation; fermenting the liquor with yeast, thereby converting the dextrose to alcohol; and then recovering the alcohol by distillation.

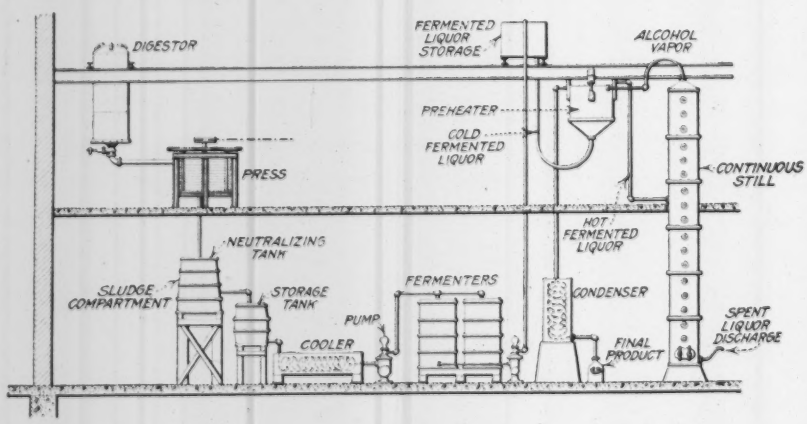
The Morgan process was brought to the attention of George A. Borden, director of public service of Columbus, in December, 1915, and referred to T. D. Banks, superintendent of the local garbage-reduction works. Mr. Banks reported that laboratory experiments on recovering alcohol from garbage had previously been unsuccessful, but the process was unlike the Morgan. Crude tests of the Morgan process were made during the first half of 1916. On July 22, 1916, at Mr. Banks' request, Charles P. Hoover, superintendent, and Walter L. Melick, assistant chemist, of the Columbus water-purification plant, were commissioned to investigate the Morgan process at the garbage-reduction works. From 2.32 to 3.60 gal. of alcohol per ton of green garbage were produced, compared with the 7.5 gal. originally claimed by Mr. Morgan as having been obtained at the Chicago garbage-reduction works.

It was then decided to give the process a fairer trial by constructing a more suitable experimental plant than had yet been used. On Dec. 18, 1916, the plant shown in outline by the accompanying illustration was put in operation. A series of nine tests was then made, after which a month was devoted to a slight remodeling of the still. The process is described as follows in a report by Mr. Hoover, dated May 8, 1917:

Course of Garbage Through Alcohol Plant

"The garbage is first weighed, 1000 lb. being used in most of the tests, and then charged into the digester, after which 2 to 4% of 60° sulphuric acid is added. The acidulated garbage is then cooked under 60 lb. pressure for two hours, when it is partially neutralized with limestone and discharged into the screw press. The liquor from the press goes into the neutralizing tank, and the solids are dried, percolated and made into tankage.

This Experimental Plant Produced an Average of 4.55 Gal. of 95% Alcohol per Ton of Green Garbage at Columbus, Ohio



DIGESTER: 3 ft. outside by 3 ft. high, of ¼-in. steel, lined with acid-resisting brick, making inside diameter about 32 in.
SCREW PRESS: Taking frames 5 ft. square
NEUTRALIZING TANK: Wood, 33 in. inside diameter, 44 in. high, with outlet 6 in. above bottom to give sludge space
STORAGE TANK: Oil barrel
COOLER: 50-ft. worm of ¾-in. copper immersed in water
FERMENTING TANKS: Two, 33 in. diameter by 44 in. high
FERMENTED-LIQUOR STORAGE TANK: 33 in. diameter by 44 in. high
HEATER: Beer heater, 1 ft. diameter by 1 ft. high, with thirty 1¼-in. brass tubes between tube sheets. Alcohol vapor in the shell surrounding the tubes is partially condensed by the cold beer flowing through the tubes
STILL: Continuous beer still, 1 ft. diameter, with 16 beer chambers and 5 rectifying chambers, all of copper, tinned on inside.
CONDENSER: 10 ft. of ¾-in. copper tubing immersed in water

"Grease is first separated from the liquor, and the liquor is then neutralized in the neutralizing tank with caustic or hydrated lime. This neutralization causes quite a precipitate to be formed, which settles to the bottom of the neutralizing tank or sludge compartment. This sludge is drawn off, dried and made into tankage.

"The neutralized liquor is cooled by passing through a coil tube surrounded by cold water, and is then discharged into the fermenters. Yeast is then added and the liquor allowed to ferment for from 36 to 72 hours. When fermentation is complete, the liquor is pumped into the fermented-liquor storage tank.

"Distillation is the next step in the process. Cold liquor from the storage tank flows into the tubes of the preheater and is heated by hot alcoholic vapors surrounding the tubes. From the heater the warmed liquor flows to the still itself, entering at a point one-fourth down from the top, where it meets an ascending current of steam, which extracts the alcohol from the liquor. The liquor trickles slowly down from chamber to chamber and is finally discharged at the bottom as spent slop. The alcohol, however, rises with the steam through the five rectifying chambers, where its concentration is greatly increased, and passes out of the top of the column to the preheater, where it is partially cooled and thereby further concentrated and purified. From the heater the alcoholic vapors pass to the condenser, where they are condensed to a liquid and received in suitable containers."

Estimates of Costs and Profits

The cost of a plant sufficient to treat all the garbage (20,000 tons a year) of Columbus by the Morgan process has been estimated by Mr. Banks and his assistant, W. D. Bee, as $36,000. The yearly charges on such an alcohol plant, including 4½% for interest and 5½% for depreciation, are $40,290. This is $2.01 per ton of garbage and $0.42 per gallon of alcohol, yielding an alcohol profit of $1.34 per ton of garbage or $0.28 per gallon of alcohol. The total annual profit would be $26,910, or 75% on the investment. These figures are for war times. The normal operating cost is put at $29,260, with a total profit of $4340, or $0.217 per ton of garbage and $0.045 per gallon of alcohol.

It should be understood that these cost and profit figures relate to alcohol production alone; that is, they do not take into account the costs of the finishing processes for grease and tankage nor the revenue from grease and tankage. It has yet to be determined just what effect the alcohol process will have upon grease and tankage. The insufficient tests, for which alone there had been time at the date of the report, showed lower yields of each than in ordinary garbage-reduction operations; but it was thought that by careful manipulation the tankage loss could be reduced to a small amount, if not eliminated, and that the grease produced would not be reduced either in quality or quantity.

Activated Sludge in India

The possibility of dealing with the sewage of Sakchi, India, a settlement of the Tata Steel Works, with a possible future population of 150,000, has been reported on by Dr. Gilbert J. Fowler. Dr. Fowler was formerly in charge and then consulting chemist of the sewage works of Manchester, England. He is now located at the Indian Institute of Science, Hebbal, Bangalore, India.

Lake Shore Protection at Chicago Being Built of Concrete

Beach Paving and Bulkheads Along Lincoln Park Are Now of Concrete To Replace Old Masonry Protection

By M. D. BLUMBERG
Assistant Engineer, Lincoln Park Commissioners, Chicago

LINCOLN PARK, a part of the great Lake Shore section of Chicago, is being extended by filling behind bulkheads placed in some 18 ft. of water and approximately 1200 ft. outshore from the old beach. The new land thus formed has to be protected along the lake line and the beach paved to prevent erosion. The work of protection now being carried on differs radically from some of the earlier protection in this general locality.

Stone Paving Torn Out by Heavy Seas

The paved beach of the old section of the park was paved for a distance of about 2½ miles with granite and limestone blocks with cement-grout filler and, for a short distance, with large concrete blocks. The early section is shown in Fig. 3. In this construction the rubble wall was not carried down very deep, and no crosswalls were built to confine any possible break. On this account and because of the innumerable joints offering entrance way to the waves, the breaks in these walls were many and extensive. The pounding of the waves and the expansion and contraction movements soon broke up the grout joints. A typical break is shown in Fig. 1.

New Type Designed Following Failure of Old

During the winter of 1913 considerable damage was done to the old beach by a severe lake storm. Breaks, varying in size from 50 to 300 ft. in length, were repaired at a cost of $25,000. Upon investigation it was discovered that large cavities had formed beneath the pavement, caused by scouring of the sand-fill through holes in the bulkhead. The pounding of the waves on the unsupported slope caused it to cave in. Constant watching and maintenance are necessary to keep this beach in good condition.

It became quite apparent that the old system of shore protection was inadequate to withstand the most severe storms of Lake Michigan, so the writer of this article, in conjunction with the chief engineer, George T. Donoghue, submitted a plan that was approved by the superintendent, E. A. Kanst, and adopted by the Board of Commissioners. This design is shown in Fig. 2. The advantage of this design over the old system is the cap-

ping of the bulkhead, the carrying down to below lake datum of the retaining wall, the use of crosswalls, the solid stone-fill and the dividing of the sections into four large blocks, thereby reducing to a minimum the number of joints.

In 1915, Picnic Island, an irregular strip of made land about 2300 ft. in length, varying in width from 300 to

FIG. 1. HOW THE OLD PROTECTION IS DESTROYED BY STORM

750 ft. and containing about 25 acres, was ready for the protection of its shore. The first shore-protection work on Picnic Island was started in April, 1915.

Concrete Retaining Wall Built First

The rear wall, which was designed to withstand the pressure of the backfill during construction, was laid out parallel to and at a distance of from 39 to 41 ft. from the bulkhead, a rock-fill between sheet piles. The elevation of the ground at the wall varied from 4 to 7 ft. above lake datum. The upper 3 or 4 ft. of the excavation was mostly material dumped by wagons, but below this was encountered sticky clay that was deposited by the dredge. Excavation was carried down to 1 ft. below lake datum. The stiff clay held up very well and required no sheeting; but long stretches of quicksand and soft clay were encountered, which required sheeting and bracing.

Although the last dredge-fill on the island was completed in 1913, there was danger of settling even after this lapse of time. The footings were therefore built first and dowels placed to bind with the upper portion of the wall. Horizontal V-shaped keyways were also employed to give an additional hold. Wood forms were used. In 1915, steel forms were tried, but on account of the narrow space between the forms and the side of the trench it was very difficult to erect them with any degree of speed, so they were abandoned.

The concrete mixer was placed alongside the forms and the concrete spouted directly into place. The wall was placed in sections varying from 48 to 60 ft. in length, the ends of the sections being formed with vertical V-shaped keyways 8 in. wide and 6 in. deep, tar paper being used for expansion joints. Rods were left to tie in with the step and with the crosswall.

Placing Concrete Cap on Bulkhead

The next step was the placing of the so-called cap on the inside line of the bulkhead. The piles were sawed off flush with the wale, and the Wakefield sheeting was left 4 in. above the wale to key into the concrete. Four men with two crosscut saws were required to do the sawing, while two men ahead of the sawers removed obstructions. The ground just back of the bulkhead was excavated to 1 ft. below lake datum, and forms were erected. The piles, wales and sheeting were thoroughly cleaned before the concrete was placed. Joints were placed only at the end of the day's run, which varied from 50 to 100 ft. in length.

In 1916 the lake level was higher than usual, and considerable difficulty was encountered in keeping the water out of the forms. Strips of canvas 18 in. wide were nailed on the bottom board of the form that rested against the wale. Sand was then packed against the canvas. By this method and with two hand pumps the forms were kept clear of water.

In the 1915 work the concrete was placed from the lake side. A 5-cu.ft. gasoline mixer with all necessary material was placed on a barge and tied up alongside the breakwater, and the concrete was spouted direct to the forms. In 1916 the marine department was in operation, and no barges were available for this work. As a new concrete mixer was needed, the commissioners purchased a machine with a high discharge that made it possible to spout the concrete from the land side.

Crosswalls Divide Protection for Safety

The excavations for the crosswalls were also carried down to 1 ft. below lake datum and built by the same methods as the main walls. They were placed on 50-

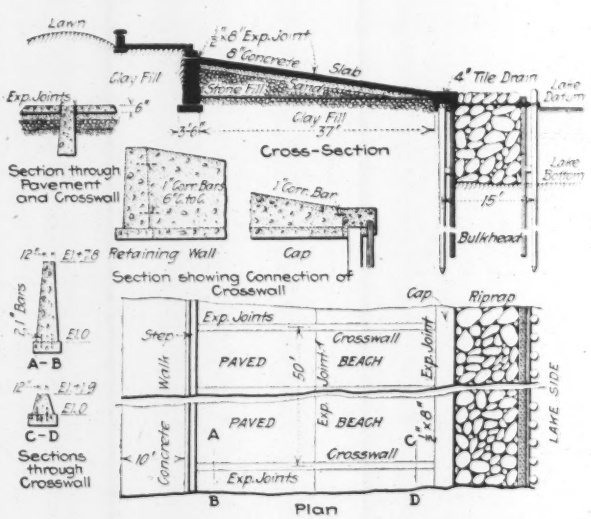


FIG. 2. NEW PROTECTION AT LINCOLN PARK CONCRETE WALL AND CONCRETE PAVING

ft. centers at the wall end and varied somewhat at the lower end on account of the curvature of the bulkhead.

The pockets formed by the bulkheads were filled with stone and sand. The stone was spread by hand and laid flat, and the sand was then spread and washed in between the stones with a 2-in. hose. The upper 6 in. was graded off with sand tamped to a smooth surface. No trouble was encountered in procuring suitable material for filling, as the island was open to the public for the dumping of such material as the commissioners saw fit to accept. The stone and sand were dumped alongside the wall and thrown over by hand until the fill

was built up sufficiently high for the teams to drive into the pockets and dump their loads.

Each section was divided into four blocks, each about 25 x 18 ft. The pavement was laid 8 in. thick, with no reinforcing. The concrete was spouted directly on the ground, spread to grade and tamped. An asphalt material was laid against a 2 x 8-in. form; and when a block was completed, the form was removed and the concreting of the adjoining block was immediately started. By the use of this material it was possible to concrete adjoining blocks without loss of time, the lower half of a section being concreted first.

The slope was finished rough by the following method: A 1:1 mixture of sand and cement was spread on the concrete before the initial set took place. Water was then sprinkled with an ordinary can sprinkler and the surface brushed with a stiff brush.

The step was concreted last. The risers and treads were given a dressing composed of one part of cement and one part of granite screenings varying from dust to ¼ in. in size. This dressing was plastered to the inside of the forms to a thickness of ¼ in. The concrete was placed by hand from wheelbarrows, with tar-paper joints every 12 ft. Every fourth or fifth joint in the step coincided with a joint in the wall. The illustration at the head of the article shows the completed beach. The walk and parapet will be built during the coming summer.

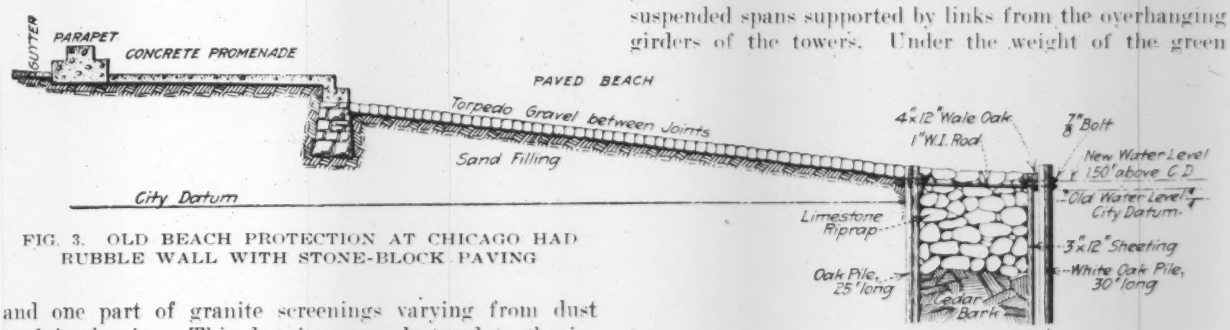


FIG. 3. OLD BEACH PROTECTION AT CHICAGO HAD RUBBLE WALL WITH STONE-BLOCK PAVING

Towers and Spouts Not Favored for Concreting

When this work was decided upon, the question arose as to whether it would be more economical to place the concrete from a central point by the use of towers and spouts or to move the plant as the work progressed. The latter method was adopted for the following reasons: The small amount of concrete to be placed did not justify the expense of erecting towers; it was not possible to concrete continuously on account of weather conditions; there was sufficient room to place material where desired; there was no difficulty in getting daily delivery of material; there was sufficient fall to spout concrete direct from the mixer; the movable-mixer scheme meant a minimum outlay for plant.

The concrete mix for the entire work was 1:2½:5. Crushed washed gravel ranging from 1 to 2 in. in size was used. For the fine aggregate, torpedo sand was supplied.

No settlement has taken place nor cracks developed in the slope of the 1915 work.

The force consisted of a timekeeper, watchman, foreman, two carpenters and from 25 to 40 laborers. The writer was in charge of the work. The unit cost of the work in 1916 was somewhat higher than in 1915. The reasons for this were the higher cost of material, higher cost of labor and bad weather conditions. In 1915, there was completed 1000 lin.ft. of shore-protection work. In 1916, in addition to 600 lin.ft. of shore-protection work, 925 ft. of retaining wall was completed. The unit cost of the work for the two years was as follows:

	1915	1916
Retaining wall, per cu.yd	$10 36	$10 43
Bulkheads, per cu.yd	9 95	13 73
Cap, per cu.yd	8 07	12 13
Slope, per cu.yd	7 78	7 85
Slope, per sq.yd	1 72	1 72
Step, per cu.yd	16 99	17 54
Step, per lin.ft	1 70	1 78
Complete beach, per lin.ft	$21 84	$24 54

Find Form Settlement Requires Camber

Early developments in the construction of the Colfax-Larimer reinforced-concrete viaduct in Denver showed that if no provision were made for settlement the resulting surface grade would be 0.1 ft. below the plan grade. The structure consists of alternate towers and suspended spans supported by links from the overhanging girders of the towers. Under the weight of the green concrete the tower spans would sag from ½ to 1 in. at their centers, according to whether steel or wood forms were used, the cantilever arms would droop about ¼ in. and the centers of suspended spans would show a total sag of ½ inch.

The foregoing result, while due in part to shrinkage, was caused principally by the compression of the joints between the component parts of the blocking, the forms and the wedges, according to Herbert S. Crocker, in a paper read recently before the Nebraska association of members of the American Society of Civil Engineers.

From this it follows that the less the blocking used, the less the trouble that may be expected from this source, and although as the work progressed wisdom gained by experience enabled enough camber to be introduced to take care of the sags, it may be remarked that the finished gradient remains below that called for by the plans. This of course is not noticeable to the observer and results in no harm. However, the wavy surface of the roadway and sidewalks had to be brought to grade by varying the thickness of the paving materials and the slabs of the walks.

This proved easy enough, especially in the case of the bitulithic pavement, but was somewhat expensive since the average thickness of this pavement had to be increased in order that all depressions might be filled and a certain minimum thickness maintained over the higher portions. This trouble was aggravated by the tendency of the soft concrete at the center or crown of the roadway slabs to spread into the gutter areas.

Overcoming Practical Problems in Mechanical Water-Filter Operation

From a Paper Before the American Water-Works Association, May, 1917—Filter Bottom Troubles, from the Same Paper, Were Published May 17

By LEWIS I. BIRDSALL

Superintendent of Water Purification, Minneapolis, Minn.

IT HAS occurred to the writer that a description of how he has met and solved certain practical problems encountered by him during his experience in the management of mechanical filtration plants might be of general interest to designing engineers and superintendents of filtration.

Keeping Coagulant Piping Open

One of the greatest problems lies in getting an ample supply of coagulant solution to the right place at the right time. When the writer assumed charge of the new Rock Island filter plant in 1911, a 1½-in. lead-lined iron pipe carried the alum solution some 300 ft. to the far end of the coagulating basin, the pipe being laid under the water of the basin. The available head for producing the flow of alum solution was approximately 4 ft. It was soon found that this line would not carry the required amount of solution because of clogging of the pipe by deposits from the alum and also because of entrained air. A hydraulic ejector was placed in the line; but while it served to remove the air, it did not remove the deposits in the pipe.

More serious difficulties arose when the alum solution began to appear where least expected. Investigation showed leaks at the threaded joints where lead did not meet lead and also at the bad spots in the piping where the lead lining was deficient. The line was mostly under water, so the difficulties were increased. Whole lengths of pipe were replaced, but the troubles continued.

The lead-lined pipe was replaced with a 2-in. composition conduit that was guaranteed to be unaffected by the alum solution. So it was; but when the water in the basin began to warm up in the spring, the conduit expanded and broke at the joints. Expansion joints of rubber hose were inserted; but when cold weather came, the conduit contracted and pulled apart. Lead and brass pipe were then tried, but these clogged up with deposits of slimy material.

C. B. Henderson, manager of the Davenport Water Co., then suggested the use of four-ply rubber hose, which was installed in 50-ft. lengths, and the troubles were eliminated. Whenever the hose clogged up, it was removed one length at a time, trod upon to loosen the deposits and then flushed out with water under pressure.

It is only fair to state that recent information from Rock Island shows that fiber conduit is satisfactory when incased in concrete or other suitable material and not subjected to extreme changes in temperature.

Experiences at Minneapolis

All coagulant lines in the Minneapolis filtration plant were of 2-in. lead pipe with brass couplings laid with a slope of 1 in. in 10 ft. on horizontal runs. The discharge lines from the solution pumps to the overflow tanks that supply the chemical-feed controllers gave little trouble from clogging, but the gravity flow lines from the controllers soon began to clog up, as did the pipes at Rock Island. The long runs of lead pipe were difficult to remove for frequent cleaning, and it became more and more difficult to get proper coagulation.

It was decided in 1914, when making additions to the original plant, to install open coagulant piping in place of lead pipe on horizontal runs. Consideration was given to open tile laid in concrete and to a concrete channel, but the scheme finally adopted was 4-in. cast-iron pipe open at the top. This was made by James B. Clow & Sons from plans prepared by W. N. Jones, erection engineer. The writer is again indebted to C. R. Henderson for the suggestion of open coagulant piping, which has solved all the difficulties formerly experienced. It is readily accessible for cleaning and for painting several times each year with a high grade of graphite or asphalt paint. No leaks have occurred in the pipe during the three years that it has been in service.

The chemical composition of the deposit occurring in the alum lines at Minneapolis may be of interest. The following analysis of a sample was made in the laboratories of the General Chemical Co., Chicago: $Fe_2(SO_4)_3$, 22.60%; $Fe(OH)_3$, 23.11; $Al(OH)_3$, 24.93; SiO_2, 12.32; H_2O, 15.96%; CaO, none; Cl, trace.

The high cost of brass has led to our using iron flanges for connecting lead to lead or lead to rubber hose on the discharge lines from the coagulant-solution pumps. The iron flange is pushed onto the lead pipe, the end of which is then expanded with a mandrel and bent over so that a lead to lead coupling is obtained at slight expense.

Chemical-Solution Agitators

The agitating devices for the chemical-solution tanks were originally of the two-blade impeller type driven by a 3-in. by 13-ft. hollow vertical shaft direct-connected to a 1720-r.p.m. motor of 2 hp. The high speed of the impellers produced excellent agitation of the solutions, but caused the bending of the drive shafts and armature shafts in the motors. Corrosion of the steel shafting and bronze thrust bearing made much trouble and a high cost of maintenance.

It was decided to reduce the speed of the agitators to approximately 600 r.p.m. by means of reduction gears; to replace the 6-in. impeller blades with wooden blades 3 ft. long; and to make steady bearings at the center of the vertical drive shafts. These changes eliminated some of the troubles, but there still remained the corrosion of the bronze bearings and the steel shafts. Also the agitators were very noisy, the motors having been set on a steel deck supported by I-beams over the tanks.

The 4-in. hollow steel shafts were replaced with 4 x 4-in. oak shafts, the two blades made of one piece of oak and having an upward thrust at an angle of 45° from the horizontal. One horizontal motor of 2 hp. and 1120 r.p.m. replaced the three vertical motors, and by means of shafting, clutches and worm drive the speed of the impellers was reduced to approximately 10 r.p.m. The blades of the impellers were lengthened so as to reach within 6 in. of the sides of the tanks. The results have been very satisfactory. The noise has been eliminated, one motor does the work of three, there is no more trouble with the shafts or impellers, and the solution is amply agitated.

Painting Concrete

The inside surfaces of all concrete chemical-solution tanks are kept well covered with a good grade of asphalt or graphite paint. It was found that the alum solution was dissolving the limestone aggregate and otherwise decomposing the concrete walls of the tanks. Graphite paint seems to give better service than asphalt, the latter gradually dissolving off. A new paint known as "Frost's Kapak Special Acid-Resisting Paint" appears to give as good results as does the graphite and is somewhat cheaper.

Concrete-floor paint has been applied to the floors of the filter house, which got dusty and were rough in spots. This has had the desired effect, has added to the appearance of the floors and gives to them a springiness that is appreciated by the workmen.

Portable Motor for Operating Sluice Gates

The sluice gates installed in the gatehouse of the original plant are hand operated, and it requires considerable labor and time to open and close them. When two new coagulation basins were added in 1914, they were equipped with sluice gates the stands of which were geared so as to be opened or closed in less than five minutes by a portable electric motor furnished by the Roe Stephens Co. from specifications by W. N. Jones. The outfit consists of a 3-hp., 660-r.p.m., 440-volt, three-phase electric motor with control board and extension cable, all mounted on a truck so arranged that the raw-hide pinion of the motor can be engaged with the gear of the stand. The truck is fastened to the stand by quick-adjusting bolts.

Electric current is obtained from suitable contacts arranged in the wall of the building. The motor is equipped with proper devices to prevent jamming of the gates and has given entire satisfaction.

Automatic Chemical-Feed Controllers

Earl chemical-feed controllers were installed as a part of the equipment in the Minneapolis filtration plant, and they have proved to be of the greatest value in operation.

Soon after they were put in service, trouble developed with the electrical-control apparatus. The hydraulic valves on the supply line were controlled by pilot valves, and these in turn by electromagnets through ingeniously arranged contact points on the ends of the balanced arm at the top of each machine. The electromagnets would stick at times unless carefully watched; then the hydraulic valves would close off entirely, thus shutting off the entire supply of chemical solution, or the valves would open wide and the machines overflow.

One other trouble that developed was the continual chattering of the electrical apparatus and the constant movement up and down of the hydraulic valves, thus causing a continual fluctuation in the levels of the system. Also, it was necessary to keep a small triplex pump running constantly to supply pressure for the hydraulic valves on those machines and a 10-volt direct-current motor-generator machine to supply current.

Balanced Float Valves and Hydraulic Control

It occurred to the writer early in 1913 that these difficulties might be eliminated by using balanced float valves and hydraulic control throughout. An experimental controller was made from soil pipe, and the plan was tried out with success. All of the electrical apparatus was then removed from the master and other controllers, and balanced float valves were installed. The master controller was equipped with two ¾-in. balanced float valves, one connected with the water-pressure line, so as to supply water to the right-hand tube of the master controller, and the other to a drain, so as to lower the water level in the same tube. The two balanced valves were then connected with a ½-in. rod attached to the balance arm on the master controller in such a manner that, as one valve opens, the other closes. The relative adjustment of the two valves was secured by turnbuckles, and the balanced arm on top of the controller was weighted so as to compensate for the pull exerted on the opposite side of the fulcrum by the two valves.

Each of the three alum and two hypochlorite controllers was equipped with a 2-in. monel-metal balanced float valve, while 3-in. valves with iron body were used on the lime controllers. Each valve was connected directly with the balanced arm on top of the controller by means of ½-in. rod and turnbuckle, as on the master controller. A glass sight tube was placed on each controller and on the master, with a graduated scale behind the tube. The result has been even more gratifying than was anticipated, and all troubles have been eliminated. The system automatically regulates itself with changing rates, and aside from a slight adjustment occasionally of the turnbuckles or cleaning of the valves no attention is required. Two triplex pumps, two motor-generator sets and complicated electrical apparatus have been eliminated, and there is no more fluctuation of levels in the system.

Liquid Chlorine

Hypochlorite of lime was formerly used at Minneapolis in conjunction with filtration. At first, the hypochlorite was added to the water upstream from the filters, but it was found that tastes and odors appeared in the filtered water during the summer months. The hypo was then added to the filtered water, and fewer complaints resulted.

In November, 1915, because it was found impossible to secure a year's contract for hypochlorite, liquid-chlorine treatment was substituted for the hypochlorite. Three Wallace & Tiernan chlorine machines were installed; and as a result, we would never again return to the use of hypochlorite, if it were possible to avoid it. There have been no complaints of taste or odor arising from chlorine treatment since we began using liquid chlorine.

Sterilization, by means of hypochlorite of lime, of all distribution mains larger than 12 in., following their installation and previous to their being placed in service, is now practiced in Minneapolis with gratifying results. Experience has shown that flushing a pipe larger than 12 in. does not entirely remove polluting material that has entered the pipe previous to or during laying. If the pipe is large enough to permit, it is thoroughly brushed out and then, as it is slowly filled, hypochlorite is added at the filling end in amounts sufficient to leave a large excess of free chlorine, as shown by tests. Bacteriological analyses are made later, to see that the water has been sterilized from one end of the pipe to the other. After the pipe has been allowed to stand full for several days, the water is completely drained out and the pipe flushed with fresh water, if suitable drains are available. Otherwise, the pipe is flushed out through hydrants until tests show the water to be free from the chlorine added.

Fitting Street Assessments to a Hillside Town

Frontage, Area, Value, Benefit or Damage and Correction for Over-Assessments Are Factors Used

By LEONARD L. HOHL
Sausalito, Calif.

A METHOD for making street improvement assessments in a hilly town with crooked streets and irregular lots is presented. It is believed that the results obtained by this method are more nearly equitable than those obtained by the ordinary front-foot method.

The following factors are taken into consideration: (1) Frontage; (2) area; (3) assessed valuation; (4) the benefit or damage to each lot by virtue of its new position with relation to the graded street; (5) correction for over-assessment, where the rates would be excessive.

The method of making the assessment is as follows: The entire cost to be assessed is distributed in amounts directly proportional to (1) the frontage, (2) the area and (3) the value as shown in Columns 5, 6 and 7 of the table. The mean of these values is then computed (Column 8). To this mean a benefit or damage factor is applied varying with the relative position of the lot with reference to the street surface before and after grading. The figure obtained in Column 8 in the case of lots in Class 1 (considerably damaged by grading) are multiplied by $\frac{3}{3}$; lots of Class 2 (slightly damaged), by $\frac{2}{3}$; lots of Class 3 (neither benefited nor damaged), by 1; lots of Class 4 (slightly benefited), by $\frac{4}{3}$; and lots of Class 5 (considerably benefited), by $\frac{5}{3}$. The results after this operation are shown in Column 10. A wider and more refined variation could be applied in cases where the conditions warrant it. The sum of the quantities in Column 10 is seldom equal to the total cost to be assessed, so that the difference between the sum of Column 10 and the desired total is distributed in proportion to the values found in Column 10 (added in the case of the example). The corrected quantities are given in Column 11. An inspection of Column 11 shows that Lots 66, 68 and 69 are assessed an amount in excess of 50% of the tax assessor's valuation—a percentage which has often been held to be a confiscatory rate. These amounts are then reduced to a sum slightly below 50% of the value, and the excess is then distributed at a uniform rate over the remaining lots, giving the final values shown in Column 12.

The example given is for the improvement of Central Ave. shown on the diagram (Fig. 1). The view (Fig. 2) shows the nature of the street; the stairway in the picture leads to Lot 17 of the diagram.

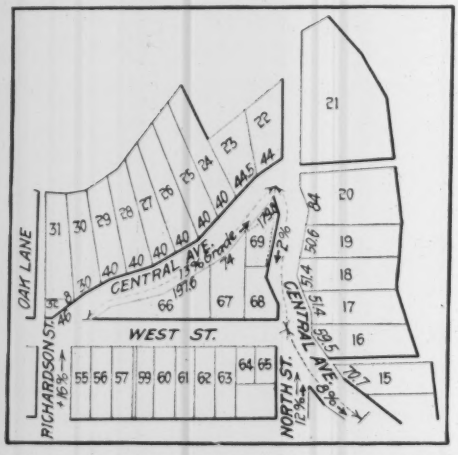


FIG. 1. FITTING ASSESSMENTS TO A STEEP, CROOKED STREET

Arrows indicate upgrades. Heavy line shows assessment district boundary. Frontages given in feet and tenths

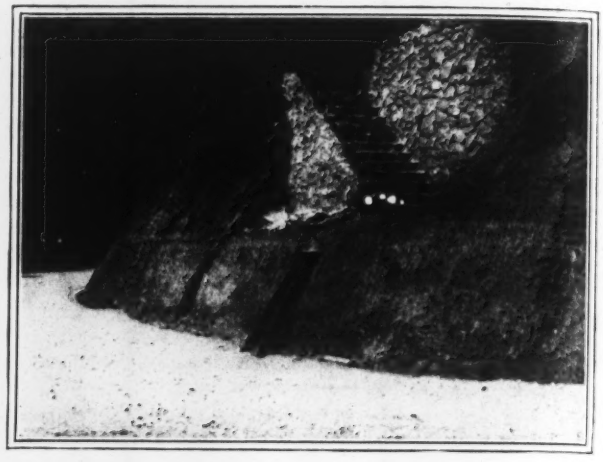


FIG. 2. STAIRWAY LEADING TO LOT 17 OF MAP, FIG. 1

METHOD OF COMPUTING STREET IMPROVEMENTS ACCORDING TO FRONTAGE, AREA AND VALUE, WITH BENEFIT FACTOR ADJUSTMENT

Lot	Frontage, Ft.	Area Sq. Ft.	Value	Cost Distributed According to — Frontage	Area	Value	Mean of Cols. 5, 6, 7	Class of Benefit	Col. 8 with Benefit Factor	Col. 10 Adjusted	Final Cost Distribution
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
16	59.5	6,900	$1,000	$152.26	$177.94	$211.05	$180.42	1	$120.28	$126.37	$136.08
20	84.0	12,000	800	214.96	309.45	168.84	231.08	3	231.08	242.33	260.95
21	0.0	23,500	1,000	0.00	606.01	211.05	272.35	4	317.73	332.97	358.20
66	197.6	7,100	400	505.66	183.08	84.42	257.72	3	257.72	270.17	199.00
68	80.0	4,000	300	204.72	103.15	63.32	123.73	5	164.96	172.94	149.00
69	179.8	3,300	300	460.10	85.10	63.32	202.84	2	169.05	177.44	149.00

An Interview:

Tendencies in Bridge Construction

Bridge-Company Engineer Talks of Increase in Loading, Simplification of Trusses, Carbon Steel, Floors and Continuous Bridges

BRIDGE men rarely write and almost as rarely talk for publication; when they do, it is of certain specific structures or of the details of design, from which, by slow process of successive observation, the initiated may draw a moral. Still, in bridge engineering, as in every other branch of engineering, it pays to stop every so often and look over the recent past to see if there are not some high spots in progress, some more or less definite steps by which the difference of today's practice from yesterday's may be marked. If some of these usually non-communicative bridge engineers could be induced to talk freely on the developments in their art, to point out definite and evident advances, the whole profession, even the bridge specialists, would undoubtedly be interested and probably benefited.

Feeling the need of some such exposition, one of the editors of *Engineering News-Record* sought out one of the guiding spirits in the engineering department of a prominent bridge company. This engineer is in close touch with all factors of bridge development and is well equipped to observe present tendencies—perhaps also to forecast future progress in a measure. The interview in some ways required careful handling. At an early stage the interviewer was likely to hear, "You understand, of course, this is confidential." To forestall such a remark, it was necessary first of all to keep out of company business, so it followed that no such blunt inquiry as "What is new in bridges?" could be put. Though some of the new things doubtless were lying on the desk at that time, policy would forbid their discussion.

The conversation, then, rather floundered at the beginning. Soon a new large locomotive was mentioned, and the engineer said something with "E-50" or "E-60" in it, which left an opening for the harmless question: "What about live-loads today; is design growing heavier?" "Absolutely yes," the engineer replied, "and it is very clearly continuing in the same direction."

"A RAILWAY bridge built 30 years ago, under standards of that time, and a bridge of today, for service of today, spans being equal, compare in weight and cost of superstructure about as 1 to 3."

Present-Day Designs Are Based on E-60

"What is present-day railway practice in bridge design? Can you average it? Your company deals with more than one or two railroads. Is the general run of first-class design about E-55?"

"Higher than that," he replied promptly, "E-60, I should say—yes, the present-day standard is distinctly higher than E-55. Of course, specifications vary, but ironing out little differences here and there to get down to a uniform basis, I believe the loading in widest use today would be found about E-60, with the American Railway Engineering method of applying E-60," the latter proviso evidently referring to unit stresses and impact.

This was definite fact from actual observations. It at once recalled to mind the published opinion of another well-known bridge engineer only a few years back, that E-55 was the designing standard—the maximum standard, barring a few special structures—and that it was also the limit of probable loading in normal railroading. Now, here was E-60 being quoted. Under the circumstances, the interviewer could not help saying, "E-60 seems high; it would mean an advance of about five points in five years, wouldn't it?"

"Yes, easily."

"That is, E-55 was best practice only a few years ago?"

"Just a few years; hardly five years ago, I should say."

"I recall it's not a very long time since the view was expressed that E-55 is practically a maximum. And you would revise that to E-60?"

"Yes, to the extent of saying that we have E-60 now."

"Not that it is a probable maximum?"

"Oh, no; I am not going to say that E-60 is a reasonable limit of design loading. I have been in the business too long for that. In the last 20 years the change has been continuous. I have seen every few years an increase in bridge loads; and about every few years somebody had the same opinion, that the limit had been reached within existing clearances or with the best locomotives that could be designed or with the available kinds of car wheel. I can remember back to when the Pennsylvania Railroad's Type R locomotive was believed to be a maximum for bridges, and that might have been equivalent to about E-30, or even less. We are taking out lots of those bridges now, but they were loaded fully up to design capacity as much as 15 years ago. No, I am not going to say that loads will stop increasing."

The Problem of Economical Live-Loading

The possibility suggested in these last words seems to carry with it the likelihood that, in designing for actual present traffic loads plus a small margin, we may repeat the experience of bridge engineers of a quarter-century ago. Their bridges would have lasted many generations—

perhaps indefinitely—if they had been built strong enough, whereas they were actually outlived in a short time and had to be scrapped after a scant 20 or 25 years. In view of the great cost of rebuilding a main-line bridge under traffic, is such designing economical?

This was not a question that could well be asked direct. As regards the bridges of the past generation, it is a complicated question. A railway bridge built 30 years ago, under the standards of that time, and a bridge of today for the service of today, spans being equal, compare in weight and cost of superstructure about as 1 to 3. The live-load in the meantime has barely doubled. There is more than merely live-load in the greater weight of a modern bridge; and as comparisons therefore are difficult, so also is it difficult to ask or to answer a question involving these comparisons. However, the engineer seemed to grasp the difficulty, for he exonerated the bridge engineers of former days with a single sentence:

"If the bridges of 30 and 35 years ago had been built for modern loads, the railway system of today could not have developed."

"CONTINUOUS bridges? They are going to be used more, I believe. We have been going through a slow progression away from pin-connected design."

This led up to the problem of what is the right live-load to use for design.

"I understand that they have designed," the engineer said, taking a specific case to explain his views, "and are building a bridge for the Bessemer & Lake Erie R.R. over the Allegheny River on the basis of E-75. That is not an emergency loading, with excess unit stresses. I understand it is considered the regular loading. They really expect to get such heavy traffic or nearly as heavy in the near future. They ought to know what they are doing. You see, the railway and the bridge company that is building the bridge are closely allied, and it is practically a home job, the designers building a bridge for themselves and paying for it themselves. So if you ask what is the economical loading to build to, we'll have to say that for that particular bridge E-75 is the answer."

"You say, in effect, that they are not specially discounting the future with their E-75. It is a present-day loading. But will it also provide for the future?"

"That is beyond me. Don't forget, however, that this is a special bridge. For another railroad E-75 would not necessarily be the right choice."

With the Bessemer bridge the subject of special steel came into view, because, like the big Metropolis structure, it is being built of silicon steel, the newcomer in the company of nickel steel et al. Something over a dozen years ago the first application of nickel steel was made in the bridge field. With this high-strength material available during more than a decade, making better and lighter design possible, might not a reaction on bridge design be generally noticeable?

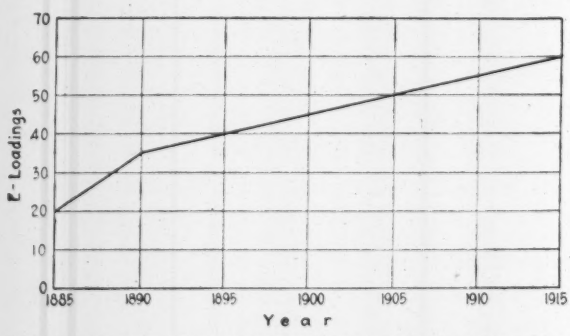


FIG. 1. STEADY RISE IN ESTABLISHED BRIDGE LOADINGS IS SHOWN BY CURVE PLOTTED FROM A BRIDGE ENGINEER'S NOTES

"I don't think that the new steels have had as much influence as the newer loading," the engineer replied in response to such a query. "As far as the details of design are concerned, larger bridge shops, tools, better equipment and improved manufacturing facilities have had the most influence. The high-strength steels so far have been little more than a necessity in special cases, long spans and the like; they have had no influence on ordinary bridges."

The subject of stronger metals, however, is persistent enough not to down very easily, and the possibility of future progress in steel metallurgy had to be considered. If the steelmakers have gradually worked out the art of producing so fine a combination of strength, toughness and uniformity as the standard structural-steel represents, can they not in time get an equally satisfactory carbon steel with higher strength? Of course, that is speculation, and the bridge engineer said as much.

"I am not sure that I can look ahead far enough for that—whether carbon steel can be improved so much that it will handle all bridge problems up to the biggest. But I recall that one of my friends in the profession has made this claim. He believes, he said, that carbon steel *is* going to do."

The upshot of this part of the conversation left obvious the fact that, so far as present practice goes, stronger carbon steel means a harder material; and harder metal than 60,000-lb. bridge steel means drilling in place of punching. So further speculation stopped in the face of the practical situation in the bridge shops—namely, that they are equipped to do some drilling, but not a great deal, and that a considerable increase in amount of drilling is out of the question. As the bridge man said, "The present shops as they are laid out and equipped simply cannot drill any large tonnage." The prospects are that this will be as true 10 years hence as now; for the bulk of our work we must depend on punching or else incur delay, trouble and undue cost. Naturally, punching means tough, ductile steel.

A question concerning truss types came up. The past 15 or 20 years have seen little change in types, except for gradual extension of all-riveted construction and the recent use of K-webbing. May not an evolution in truss types be under way? What are the present tendencies in truss design? The answer was clear cut and specific.

"The tendency at the present time," he said, "is toward simplifying trusses, using longer panels, simpler arrangement of bracing and, wherever possible, eliminating subwebbing (see Fig. 3). It is not so long ago that short panels—even 15 to 18 ft.—were the regular thing, where today we are putting in 30- to 32- and 34-ft. panels or longer. I am speaking now of ordinary bridges—not those of very

long span. There are several reasons for this: reduction of secondary stresses is one, but more prominent is the effect of manufacturing advance and progress in erection appliances. Credit must be given to the increased possibilities of derrick-car and locomotive-crane erection. These tools can handle the heavier loads at longer reaches in at least the same proportion as shops can build economically longer and heavier members than formerly."

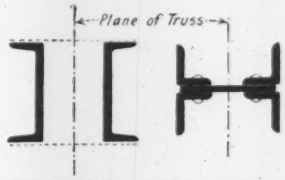


FIG. 2. TENSION DIAGONAL OF A BRIDGE 20 YEARS AGO AND NOW

"Are these other factors of leading influence?" "By all means; secondary stress is the last item of influence. I don't believe very many engineers ever avoided subpaneling for fear of secondaries.

"We design for least total cost, of course. Weight of structure is only one factor; otherwise the longer panels would not be economical. But, for instance, while subpaneling might reduce the weight, saving more in the floor than it adds in the trusses, yet it would run the shop cost right up. Submembers are expensive in the shop, and they cost more in erection."

"But does not this simplification extend beyond mere truss design?"

"Precisely. The same tendencies go all through the detailing, into the bracing, the sections of members and all. Just for instance, take a tension diagonal in a riveted bridge. Twenty years ago we would have made it like this: A pair of channels—flanges cut for easy riveting—and lacing top and bottom. Today we make it different: A plate and four angles, the web horizontal (see Fig. 2).

"All the metal works. There is no wasted expense and weight in details. Only two lines of rivets are used, and the end connections are simple in the field. The modern section is sturdier, too; less likely to get out of shape or to suffer damage in shipping or handling. That same principle goes through the whole design."

Concrete Floors Have Been an Important Factor in Bridge Development

The conversation switched to concrete bridges for a few minutes. On the question whether there had been any reaction of concrete design on steel design, the bridge engineer said he did not think so. When for a score of years two very different bridge materials exist side by side and compete with each other in a certain range of dimensions, it might be expected that the development

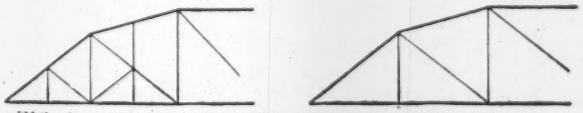


FIG. 3. TRUSS OUTLINES BECOME CONSIDERABLY SIMPLER WITH LONGER PANELS

of practice in the newer material would produce some sympathetic effect on practice in the other.

"Only through the development of concrete-floor types, I think," said he. "Concrete floors have influenced design quite distinctly. In bridges for certain classes of service they have practically done away with trough floors. There was a time when, if a man had a solid bridge floor to build, he used trough construction, like this (left-hand sketch, Fig. 4). The reinforced-concrete slab (right-hand sketch) is the better floor nowadays. There are transverse I-beams between the girders—if it is a girder bridge over a street, for instance—and a concrete slab over and around the beams. That gives a tight, strong rigid floor that you can forget about once it is finished."

Opinion on Solid Floors

"Does such influence extend to ordinary bridges and truss spans?"

"Only occasionally. As a general thing it has to do only with bridges over streets, in grade-crossing elimination and such structures."

"Then there is no present tendency toward solid floors on truss railroad bridges?"

"Mighty little. From the run of matter that goes through this office I should say that perhaps 95% is the old standard open-tie construction. With longer panels coming into use, heavier loading and above all the high impact that is always counted nowadays, the floor steel is a much more important element of the total weight, but this has no present effect toward producing changes in truss design. Such an effect is bound to come in time."

Continuous-Bridge Types Will Gain Favor

"There seems to be a strong development just at this moment," said the interviewer, "in continuous-bridge construction. How do you look on this with regard to future development?"

FIG. 4. FORMER TROUGH FLOORS AND MODERN

"Continuous bridges? They are going to be used more, I believe. We have been going through a slow progression away from pin-connected design. Had the craze for pin bridges that prevailed a generation ago for a short period continued, we would not be ready to do much in continuous spans; but as it is, the present standard practice in truss details is entirely suited to continuous bridges, and at the same time we have outgrown any fears that may have existed formerly as to the certainty of stress calculations in continuous structures."

"What about these indeterminate stresses?"

"It used to be thought, that, if the supports should settle even a trifle, the stresses would be very seriously changed. On that subject we have clearer notions nowadays. Every bridge engineer appreciates that, no matter how rigid a bridge, a long span is in fact quite flexible and any minor settlement of a support such as could occur in a normal case would have only trifling influence on the stresses. Continuous spans are going to be used more in the future. That's a very definite opinion. I feel it quite strongly."

Panama Has Largest Locomotive Jib Crane

All-Steel 500-Ton Steam-Operated Self-Contained Machine with 113-Foot Boom Travels on 22-Foot Track at Balboa Yards and Dry Docks

ONE of the largest and most unusual machines ever built for handling heavy equipment is the 500-ton locomotive jib crane just completed for the Panama Canal dry docks and yards at Balboa. It is of all-steel construction and is steam-operated and self-contained. It consists of a box-girder underframe, supported by eight two-wheel trucks and supporting the revolving table that carries the jib, counterweight, hoists, boiler and cab. The main dimensions are shown in the accompanying sketches. Wheel loads range from 50 to 72 tons. The crane has three hoists. The main hoist is capable of lifting, lowering, holding or swinging 56 tons at a maximum working radius of 87 ft. from the center of rotation, in which position of the boom the load can be raised at a speed of 10 ft. per min. and to a point 55 ft. above the rails. With the boom in the same position the auxiliary hoist (capacity 16½ tons) will have a radius of 97 ft., and the whip hoist (capacity 3¼ tons), 102 ft. The auxiliary hoist has a speed of 20 ft. per min.; the whip hoist has a speed of 40 ft. per min. Unloaded hooks travel at double speed and lower themselves on reversing the drums. The jib can be lifted from the ground. The minimum working radius, for the main hoist, is 60 ft.; at any radius all hooks can be lowered 56 ft. below the rails.

On tangents the track rails are 22 ft., center to center; the steel is a 135-lb. Pennsylvania section (No. 290). There is a curve of 86-ft. radius around the end of the Balboa dry dock, and here the rails are spaced 21 ft. 9½ in. center to center.

The 16 wheels are fixed on short axles and mounted between railway-type journals, two wheels to a truck. The eight trucks are placed in tandem pairs under four equalizers; the latter in turn are placed one under each corner of a square frame, of four riveted box girders, made up of web plates, angles and plates with cross and diagonal girder bracing. On this box-girder frame rests the live-ring on which the revolving part of the crane turns.

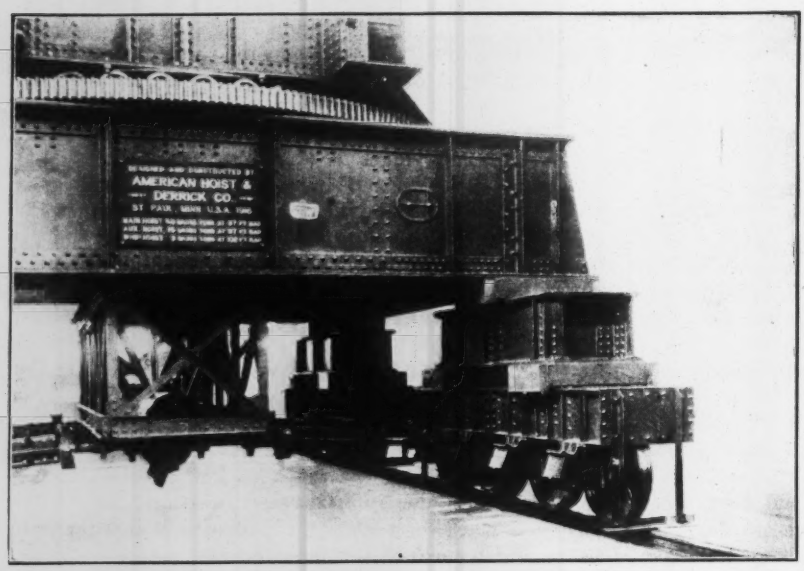


FIG. 1. FOUR TWO-WHEEL TRUCKS SUPPORT PANAMA 550-TON CRANE

One pair of wheels under each corner drives, the power being transmitted by horizontal shafting through universal joints. The difference in wheel travel in rounding curves is cared for by two sets of differential gears.

The live-ring is made of upper and lower cast-steel beveled roller paths, with apex at center of rotation, and between them are 60 cast-steel rollers of 12-in. diameter, on axles fixed at the center of the pivot, but adjustable as to axial position. The rollers are bronze bushed.

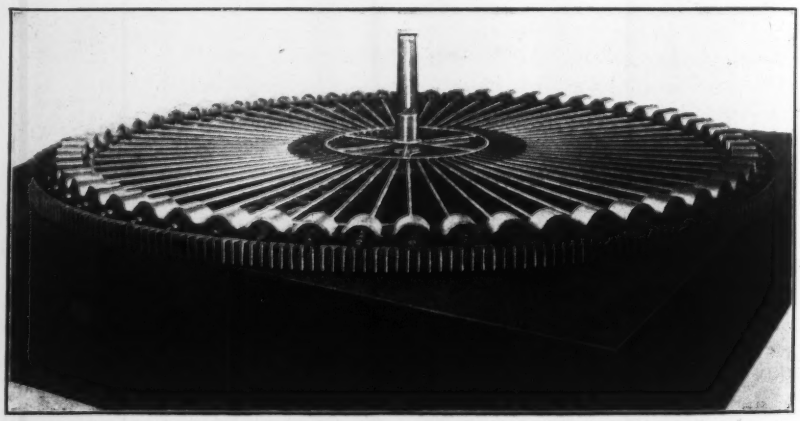


FIG. 2. THERE ARE 60 ROLLERS IN THE RACER BEARING

The main revolving base, or "racer," is a heavy built-up structural member of beams and girders, to the bottom of which is fastened the upper roller path and in the center of which is a large bearing or pivot to prevent the overturning or tipping of the revolving part on the lower base. This revolving base carries the jib, all operating machinery, the steel-concrete counterweight of 486,000 lb. (made by filling in unoccupied space in the racer platform back of the hoists and permanently fixed in position) and the A-frame, at the top of which are mounted the sheaves for raising the 113-ft. boom.

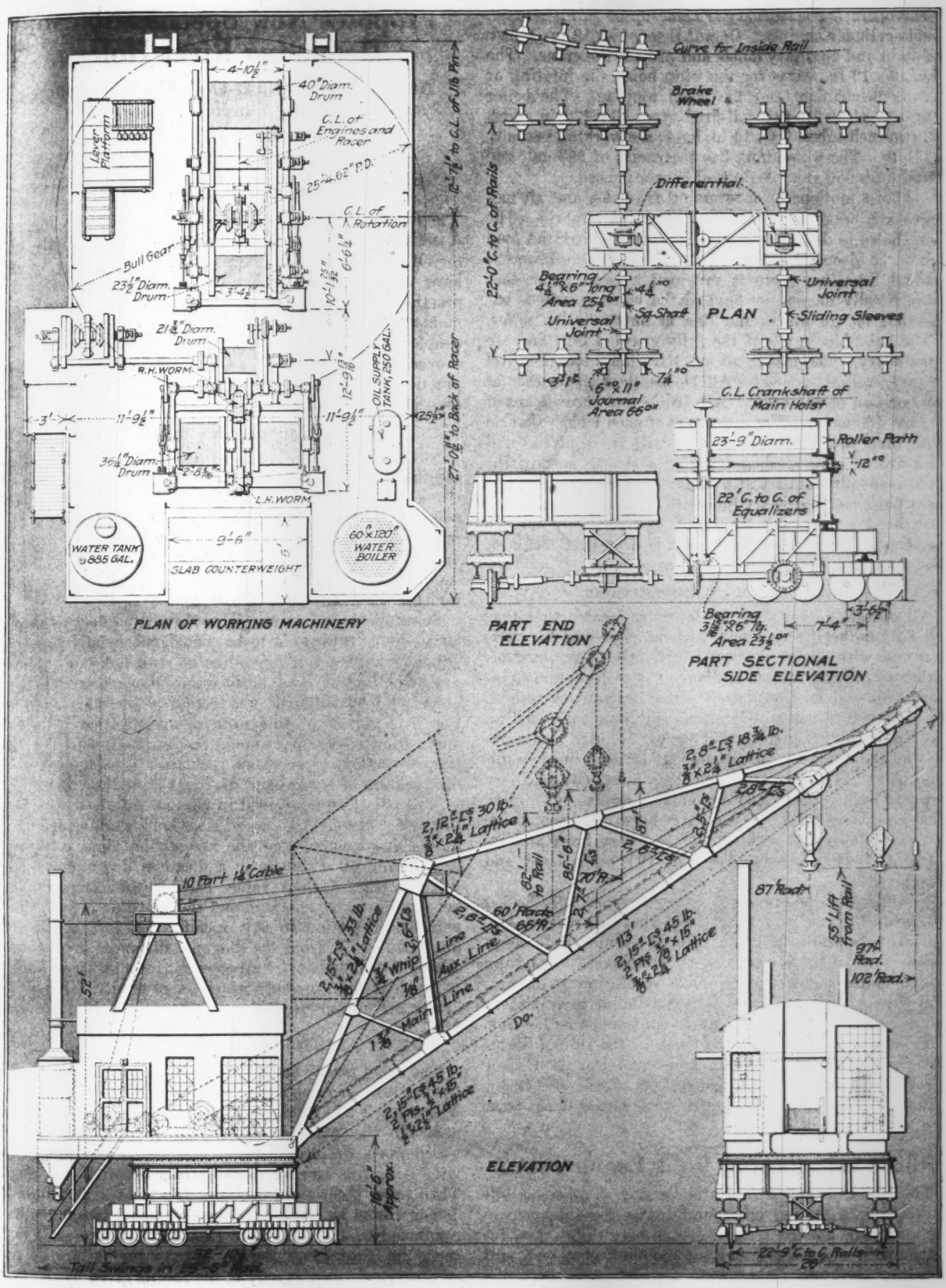


FIG. 3. PANAMA LOCOMOTIVE CRANE SHOWS UNUSUAL FEATURES

The operating machinery is made up of two horizontal double-cylinder engines. One of them, 10 x 12 in., moves the main and auxiliary hoists and propels the crane. The other, 9 x 10 in., cares for the whip hoist, the rotating or slewing mechanism and the boom topping. The boiler is of a vertical fire-tube oil-fired type, 60 x 120 in., with 253 two-inch tubes, 7 ft. 1⅝ in. long; the working pressure is 125 lb. The water tank has a capacity of 885 gal. and the oil tank 250 gal. A Best oil burner is used.

All hoist motions have reversing frictions, and all motions have brake bands lined with asbestos fabric. The boom hoist is driven by worm gearing, so that the load cannot be dropped under any condition; to prevent a gradual lowering, there is provided a band brake that automatically loosens its hold as the boom is raised, but does not let go unless the line is unwound by power.

The hoist blocks are of the fully guarded type and are extra heavy. The main and auxiliary hoist blocks swivel on taper roller bearings. All blocks clear each other at any position of the boom. All drums and sheaves are of 30 rope diameters. The drums are of such length that no more than two wraps of the rope will be required. All lines are of plow steel and are of a size to sustain the rated loads plus impact at a factor of safety of five. The main hoist has a six-part line with 1⅜-in. rope, the auxiliary hoist a four-part ¾-in. line, and the whip hoist a single ¾-in. line. The boom hoist is a 20-part tackle of rope running from two drums to an equalizer.

One Man for All Operations

All operations are made by levers so located that they can be handled by one man without changing his position and with slight physical effort. One lever controls both forward and reverse motions. As each motion is independent and friction driven, either forward or reverse, it is possible to make all motions simultaneously, within the power of the engines and boiler. Under maximum loading the following operations may be performed simultaneously: (1) Main hoist and whip hoist, (2) auxiliary hoist and whip hoist, (3) travel and revolve, (4) main hoist and boom hoist, (5) auxiliary hoist and boom hoist, (6) main hoist and revolve, (7) auxiliary hoist and revolve, (8) whip hoist and travel, (9) boom hoist and travel.

The speed of the crane on its tracks when fully loaded will be 120 ft. per min. in still air, ahead or reverse, and not less than 100 ft. per min. against a wind producing a pressure of 10 lb. per sq.ft. vertical surface. The fully loaded crane makes one complete revolution in 2 min. The time to luff full load from maximum to minimum radius is 7 min. Slewing may be continuous either way.

This crane was designed and built for the United States Government by the American Hoist and Derrick Co., of St. Paul, Minn., under the direction of Oliver Crosby, managing partner and chief engineer. The contract price was approximately $60,000.

Rhode Island Levies Road Tax on Towns

The Rhode Island legislature, an Apr. 3, passed a bill authorizing a tax on cities and towns for the purpose of improving and constructing highways. This tax, together with Federal aid and automobile license fees, will give the Highway Department approximately $400,000 for 1917 work. Some of this money will be spent for concrete roads.

Proposes New Specification for Deducting Rivet Holes

Net Sections of Built-Up Tension Members Obtained by Simple Practical Rule Which Agrees with Theory

By D. B. STEINMAN

Associate Engineer, Waddell & Son, Consulting Engineers, New York City

IF THE requirements of existing specifications for net sections of riveted tension members were strictly observed, an unnecessarily large number of holes would have to be deducted in most of the cases occurring in practice. As an alternative, draftsmen and detailers commonly ignore the specifications and substitute some simpler rule of doubtful safety. The specification here proposed is the result of an attempt to devise a simple practical rule which would agree with theory more closely than present specifications.

Present Methods and Specifications

Any correct method of figuring net areas through zig-zag lines of rivets must take into account the increase of stress on diagonal sections as a result of the shear component in such sections. This effect is customarily disregarded by detailers, and they are encouraged in such practice by tables in standard handbooks which simply compare square and zig-zag net sections with no correction for the augmented stresses in the latter.

Some specifications recognize the above effect by stipulating that "rupture is to be considered equally probable either through a transverse line of rivet holes or through a zig-zag line of rivet holes where the net section does not exceed by 30% the net section along the transverse line." A defect of this form of specification is in the application of the percentage factor to all parts of the zig-zag section, even where the latter is composed of a combination of square and diagonal lines.

This objection is avoided in another standard specification which reads "All rows of rivet holes shall be deducted unless so staggered that the net section along a zig-zag line, taking all distances in a diagonal direction at only three-fourths of their value, exceeds the corresponding net section taken square across the shape or plate." The principal objection to this specification is that the deduction of 25% from the diagonal distances is excessive. It would usually require all rows of rivets in flange angles to be deducted, a result which is generally rejected by draftsmen as unreasonable.

The Correct Theory

The exact theory and formulas for net sections through zig-zag lines of rivet holes were given in the *Engineering News*, April 23, 1908, page 465, and May 6, 1915, page 893. In the latter article there was presented a chart which gives the resulting deductions, in fractions of a rivet hole, for varying combinations of pitch and gage. That these theoretical conclusions are safe to follow is demonstrated by the latest tests on riveted tension splices conducted by the Deutscher Eisenbauverband (see "Versuche im Eisenbau," Berlin, 1915); the failure of net sections conformed exactly to the results given by theory.

Applying the theoretical formulas, it can be shown that the increase of stress on a diagonal section, due to the

effect of shear, does not exceed 16% in the severest case (which is an inclination of 55°). Consequently a reduction of diagonal distances to 85% of their value should always give safe results, and there is no necessity for a larger reduction.

Proposed Specification for Net Sections

Prompted by the above considerations the writer proposes the following as an improved specification for net sections: *The net section of a plate or shape shall be defined as the least section obtainable across the rivet holes, square or zig-zag, taking every net distance in a diagonal direction at 85% of its value except where 85% of the distance is less than the square projection, in which case the latter shall be used instead.*

This specification will give results uniformly closer to those of the exact theory than any of the present standard specifications, and it avoids the many anomalies encountered in the application of other specifications. The last clause in the specification can be omitted; but its insertion provides an automatic correction of the 85% factor whenever the slope of the diagonal line approaches the transverse direction.

Examples

In the case of a plate girder flange the arrangement of rivets in the cover plate is shown in Fig. 1. Applying the writer's specification, the different net sections are found to be:

$$ABEF = 2 + 12 + 2 = 16 \text{ (}or\text{ 2 holes out)}$$

$$ABCDEF = 2 + 2.91 + 5.5 + 2.91 + 2 = 15.32$$
(*or* 2.68 *holes out*)

$$ABCEF = 2 + 2.91 + 8.75 + 2 = 15.66$$
(*or* 2.34 *holes out*)

The second value is the smallest and should be used for design; it corresponds to deducting 2.68 holes from the gross section. The application of the exact theoretical formulas, or the corresponding chart previously mentioned, would take out 2.50 holes which is a sufficiently close check. Cooper's, Seaman's, Waddell's and other standard specifications would require deducting four holes, while the customary practice of draftsmen would take out two holes only.

Similarly, in the flange angle shown developed in Fig. 2, the net section by the writer's specification would be

$$GHKLMN = 1.25 + 2.91 + 4.25 + 2.91 + 1.25$$
$$= 12.57 \text{ (}or\text{ 2.68 holes out)}$$

The exact theory would take out 2.45 holes, whereas all standard specifications would deduct four rows of holes.

The above comparisons indicate that the proposed specification is more rational and economical than the specifications now in use.

A Simplified Form of Specification

Another simpler form of specification for net sections, dispensing with the figuring of diagonal distances, reads as follows: "The greatest number of rivet holes which can be cut by a plane square across the member, or come closer than two inches of the plane, are to be deducted from the gross area of section." Different specifications of this type give the required distance from $1\frac{3}{8}$ to $2\frac{1}{2}$ in. The objection to rules of this form is that they are unsafe to follow for the larger values of the gage between rivet rows. The amount of prescribed stagger should increase with the value of the gage.

Equivalent Practical Rule

Adopting the underlying principle of the above specification, however, in order to secure its advantage of simplicity, the writer proposes the following empirical rule. It will yield results consistent with the proposed new specification but may be more convenient in actual application:

To find the net section across a chain of rivet holes: After deducting the first hole, each successive hole is to be deducted if its stagger s with respect to the preceding hole does not exceed one-half the gage g, and no deduction is to be made if the stagger equals or exceeds the gage. For intermediate values of the stagger ratio, a fraction of the hole is to be deducted as may be obtained by interpolation, that is, deduct $2(g - s)/g$.

This rule is illustrated by Fig. 3. After deducting the top hole, deduct 1, $\frac{1}{2}$ or 0 hole for the next rivet if located at the respective points shown. Applying this equivalent practical rule to the preceding examples, we find that there should be deducted from the cover plate (Fig. 1)

$$BCDE = 1 + 0.16 + 1 + 0.16 = 2.32 \text{ } holes,$$

and from the flange angle (Fig. 2)

$$HKLM = 1 + 0.16 + 1 + 0.16 = 2.32 \text{ } holes,$$

as compared with 2.68 and 2.68 holes respectively, required by the writer's specification.

The equivalent practical rule may be preferred by some to the more exact form of the proposed specification; but the writer recommends that the latter be adopted and that the rule be used in conjunction therewith as a simplified method, or short-cut for the practical application of the specification by draftsmen and detailers.

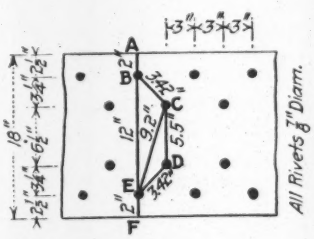


Fig. 1

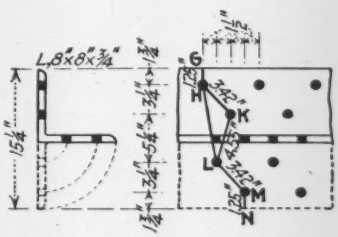


Fig. 2

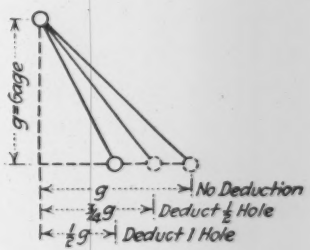


Fig. 3

DIAGRAMS ILLUSTRATING APPLICATION OF NEW RULES

Lake Port Improvements Many and Varied

"Engineering News-Record's" Canvass of Work Under Way or Contemplated Includes Many Breakwaters—Great Ore Docks Are the Features at Duluth and Ashland

THE numerous ports on the Great Lakes require in the aggregate a vast amount of engineering construction work for their maintenance and improvement. This includes work done by the United States Government (War Department), state and municipal authorities and various private interests in the way of railway, shipping and manufacturing concerns. For a review of some of the work now in hand or contemplated for 1917, inquiry has been made of the United States engineer officers, local authorities and chambers of commerce. The information thus obtained is compiled and summarized below. No attempt was made to cover each and every port, but most of the leading commercial ports are included. While little mention is made of dredging, it may be explained that in a large number of ports work of this kind is done regularly by the United States Government, under the Corps of Engineers, U. S. A., both to maintain and improve the harbors and their approach channels.

Lake Michigan Ports

At Chicago, Government and city breakwaters will constitute the main harbor work in 1917. For the Government there are three contracts now in force, as follows: 750 ft. of timber-crib breakwater extending from the north arm of the outer breakwater toward the shore, to be completed in November; 2270 ft. and 2730 ft. of rubble-mound construction from the south extension of the outer breakwater, to be completed in August, 1917, and August, 1918, respectively. The city work is a 2000-ft. breakwater 500 ft. north of the Municipal Pier, so as to protect vessels lying at the pier. At some future time this may form the face of an additional pier. The breakwater will have two rows of 60-ft. piles 24 ft. apart, with a line of sheet piling behind one row to retain a rock-filling. The work is now under way and will cost about $190,000.

At Milwaukee, extensive developments have been planned for both the inner and the outer harbors, but no complete plan has been adopted. The principal work for 1917 will be the construction of bulkheads or revetment on the lake shore north of the river, and along Jones Island, in order to protect the fill for reclaiming land upon which municipal terminals may be located.

Lake Superior Ports

At Duluth, a large ore dock is being erected by the Duluth, Missabe & Northern Ry., and at Superior an ore dock of steel construction is being built by the Northern Pacific Ry. The only Government work proposed for the Duluth-Superior port is the dredging in the harbor. At Marquette, Mich., the United States Government is building a 1300-ft. extension to the breakwater, but recent bids were so high that no contract was let for the completion of the work.

At Ashland, Wis., a large amount of private improvement work is under way. The Chicago & Northwestern Ry. is completing its third ore dock—of timber construction—at a cost of $1,000,000, and is said to intend building a fourth dock. In addition, it is spending a considerable amount on new yards and terminals. The Soo Line is completing its second ore dock, this being a concrete structure costing about $1,500,000. Large extensions and improvements on the coal docks are being made by two or three companies. The city has recently purchased 150 ft. of harbor front, increasing its frontage to 650 ft., and this is expected to lead to the construction of a municipal dock for handling package freight. Pending such construction the city may improve the Soo Line dock for this purpose, as it controls the dock under a long lease.

Lake Erie Ports

At Detroit, Mich. (on the Detroit River), the only work of importance is the building of a new wharf or bulkhead wall on the harbor line (about 100 ft. out from the present wharf) and filling in the reclaimed space. This is being done by the Michigan Central R.R. (from 3d to 8th Sts., with about 2½ acres of made land) and by two steamship companies. The work consists of a concrete wall on pile foundation, with earth-filling. At Toledo, Ohio, the principal work is a large dock now under construction for coal and freight shipments, in connection with the new power plant of the Toledo Railways and Light Company.

At Sandusky, Ohio, little work is to be done. The city had pledged a large sum to be used in conjunction with expenditures by the United States Government. With the defeat of the Rivers and Harbors bill this project fell through, and with it some supplementary private improvement work. At Conneaut, Ohio, the completion of the east breakwater, with pier head of timber cribbing and concrete superstructure, is under contract by the United States Government and is expected to be completed in 1917.

At Lorain, Ohio, about 100,000 cu.yd. will be dredged from the Black River for maintenance work, but no new construction is planned. In 1918, however, the city will probably extend the navigable channel of the river about 3000 ft. by dredging, at a cost of over $200,000. Some of the large local industries are expected to build docks or wharves along the river in connection with this improvement. The United States Government will let a contract for 112 ft. of bulkhead (steel-pile construction) to connect the city dock with the Government pier. This work will be done this year.

At Cleveland, Ohio, no extensive municipal improvements for waterfront or harbor facilities are contemplated for the near future. The most important project is the straightening of the Cuyahoga River, as described in *Engineering News-Record*, May 3, 1917. In the event of certain work being done by the Pennsylvania Co. and the New York Central Lines in connection with the proposed union station, there will be some bulkhead work along the lake front. There is a project also for the construction of municipal piers and slips in front of property

that will come under control of the city as a result of the union-station work.

Development of the lake front has been retarded by the complexity of state laws and court decisions as to ownership of lake-front property. The Fleming law, passed at the last session of the Ohio legislature, is intended to clear the situation by constituting the lake cities agents of the state to administer lake-front developments. In regard to work by the United States Government, bids were received recently for repairing about 4000 ft. of rubble-mound breakwater and reinforcing 2000 ft. of the west breakwater by stone riprap on the lake side. This work will be completed probably in 1917 or 1918. The repair of 1550 ft. of stone-filled timber-crib breakwater and the construction of new stone superstructure are under contract and expected to be finished in 1917.

The work of the Government, state and municipal authorities and private interests, at the port of Buffalo makes an aggregate of considerable importance. The work of the United States Government for 1917 includes the completion of the deepening of the north entrance of the outer harbor to 25 ft. by means of rock excavation and the construction of a stone-and-concrete superstructure on 800 ft. of the outer breakwater to replace the old timber superstructure. Dredging of certain parts of the outer harbor to give 23 ft. of water is proposed, but depends upon the authority of Congress.

The mooring of vessels at the North Pier having been prohibited by the War Department, the Delaware, Lackawanna & Western R.R. has dredged inside of this and built a new pier and coal-car dumping machine 90 ft. back from the old pier. Appropriations are available for continuing the deep-water channel at Tonawanda, and the work is said to be awaiting action by the cities of Tonawanda and North Tonawanda in lowering their water-intake pipes to permit this improvement.

The State of New York is carrying on the work of its Barge Canal terminals, which are to cost about $11,000,000. These are in two parts. The Erie Basin, which is intended to be a meeting point between lake vessels and canal barges, has two new piers constructed, at which the largest lake boats can land; and the work of deepening the channel or approach is under way. For the Ohio Basin, contracts have been let and work is about to begin, which will provide a harbor space for canal barges and access for all but the largest of the lake vessels. This work will consist of deepening the basin, constructing new dock walls, etc., which will allow the future construction of warehouses and loading facilities.

The City of Buffalo is deepening and enlarging the channel of the Buffalo River upstream from the original limits of navigation. This improvement now extends about three miles, and on this portion four railway bridges have been reconstructed, with bascule drawspans, allowing the passage of large vessels. The fifth bridge is a city highway bridge, which is now under reconstruction; and the channel has been deepened about ¾ mile beyond this bridge. The channel for nearly a mile farther is under contract for excavation, and operations will be continued as fast as adjustments of right-of-way can be secured. It is probable that a portion of this work will be done this season.

On the general outer harbor, extending south from the Buffalo River about three miles to the Lackawanna Steel Co. plant, the improvement of the waterfront has awaited adjustment of numerous conflicting interests. Six years ago a contract was made between the city and various railway companies controlling most of this land, and under this contract the work of access by providing highways has materially progressed. But actual improvement for service to commerce has been impossible until the State Land Board made grants of various lands under water.

In April, 1917, the first of these grants was made, and it probably establishes a precedent on which the remaining grants will be given. This will permit the early development of the outer-harbor property. It is understood that one large industry at least has been awaiting this settlement to begin improvement. Along the northerly half of this waterfront the city owns a strip of land that will provide a highway and also space for switch-track extensions to serve the property. While the city had once condemned this land, it had never cleared it of obstructions; and the squatters' rights have been adjusted through eminent-domain proceedings, which will be approved by the council shortly. This step will make possible the construction of highways along this portion and allow for the early development of the area for industrial purposes. It is thought the available sites will be quickly taken up.

On the Niagara River front, the city obtained a grant of about 3000 ft. of the so-called Bird Island pier, which separates the United States ship canal (passing the rapids of Niagara River) from the river; and the improvement of this property is under way. Ultimately, it will give a waterfront park of about 23 acres, and on the river front will be situated docks for excursion boats and also accommodations for the Canadian ferry to Fort Erie. Some of this wall has been completed, and it is expected that about 1000 ft. additional will be constructed this year, including the ferry and excursion-boat landing and facilities.

On the inner harbor, formed by the Buffalo River and the artificial channels, are a number of small islands lying between the river and the city's ship canal. These are under negotiations for purchase by the city, that they may be partly removed, enlarging the turning basin at this point and providing for further development of property on this inner harbor. It is probable that these adjustments of various interests will be made this season. Most of the port facilities at Buffalo are controlled by private interests and are being gradually improved, but there is no general plan for the provision of material additional facilities except for individual plants and industries. The most extensive of these are for the Donner Steel Co., which is constructing new docks for handling ore and for other purposes in connection with its plant.

Port Improvement Work Under Way or Contemplated

Breakwaters at Chicago
Revetment Work at Milwaukee
Ore Docks at Duluth and Ashland
New Wharf at Detroit
Coal and Freight Dock at Toledo
Waterfront Improvements at Cleveland
New York Barge Canal Terminals
Channel Enlargements at Buffalo

Girderless Reinforced-Concrete Floor System Has Straight-Bar Reinforcement

New Flat-Slab Floor Distinguished by No Bends in Bars and by Chairs That Hold Reinforcement Definitely in Place

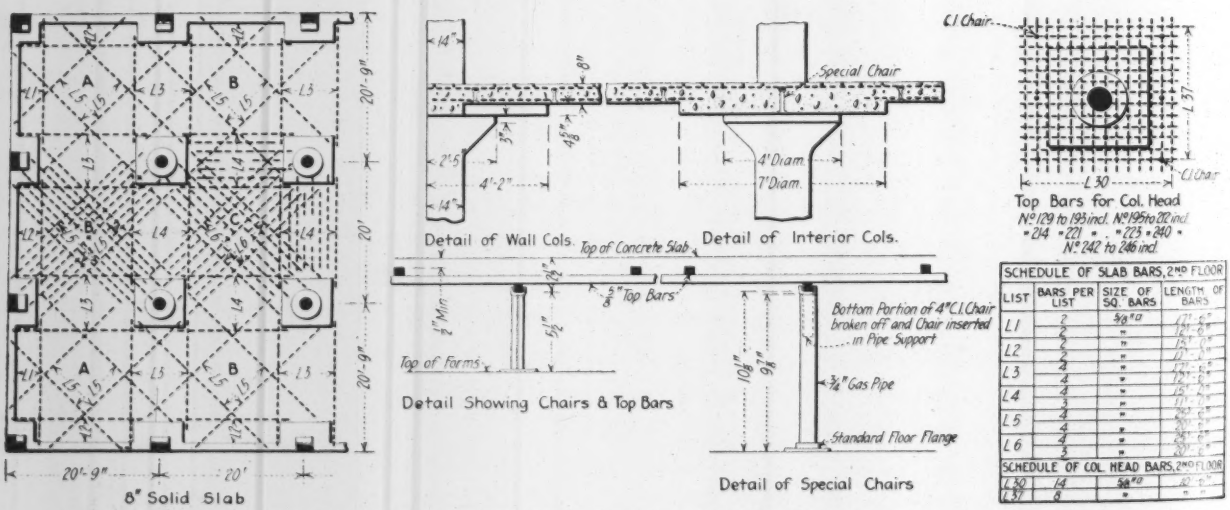
FIG. 1. INTERIOR OF BUILDING IS SIMILAR TO OTHER FLAT-SLAB CONSTRUCTIONS

A FLAT-SLAB, or girderless, reinforced-concrete floor of some novelty is now being used by W. E. Wood Co., building contractor, of Detroit, Mich., in a number of buildings throughout the country. The system, for which an application for a patent has been made, was devised by John Nydegger, of the Wood company, and is known as the "Straight-Bar System of Flat-Slab Construction."

What the Design Was Intended To Do

The intention of the designer was to fulfill the following requirements:

1. Eliminate all bending.
2. Provide supports for column-head steel which will make the steel easy to place and hold it absolutely in the correct position regardless of all ordinary rough usage.
3. Provide a zone for the travel of the line of inflection, which zone shall be reinforced in both top and bottom of the slab. In other words, the column-head steel and the bottom bars must overlap for a certain distance on each side of the line of inflection as established by uniform loading.
4. Provide column-head reinforcing in two directions only, so as to avoid too close a network of bars and so as to keep the center of the steel as near the top surface of the slab as possible.
5. Provide steel bands in four directions for the main-panel reinforcement.
6. Provide bar supports and spacers for the panel bars, which will hold them in proper position.
7. Reduce the number of different sizes and lengths of bars to a minimum.
8. Simplify the placing of steel.
9. Devise a method of computing, detailing and listing which will be simple and applicable to all ordinary forms of flat slab, with or without depressed heads, etc.



SCHEDULE OF SLAB BARS, 2ND FLOOR			
LIST	BARS PER LIST	SIZE OF SQ. BARS	LENGTH OF BARS
L1	2	3/8" sq	121'-6"
	6	"	121'-6"
L2	6	"	121'-6"
	2	"	121'-6"
L3	2	"	121'-6"
	4	"	121'-6"
L4	4	"	121'-6"
	3	"	121'-6"
L5	3	"	121'-6"
	4	"	121'-6"
L6	4	"	121'-6"
	2	"	121'-6"

SCHEDULE OF COL. HEAD BARS, 2ND FLOOR			
L30	14	5/8" sq	42'-2"
L37	8	"	"

FIG. 2. NEW FLAT-SLAB CONCRETE FLOOR AS PLACED IN BUILDING AT FORT WORTH, TEX.

The details of the system may be best described by reference to a typical floor, that built in the assembling plant of the Chevrolet Motor Co., at Fort Worth, Tex., as shown for typical corner, exterior and interior panels in Fig. 2.

The bar layout consists of diagonal and rectangular bands in the lower part of the slab, in both of which only alternate bars extend over the drop head above a capital and column. In the upper part of the slab there is a crossframe of bars over the column head, all of the bars in which extend well beyond the depressed head and thus overlap the lower flange band bars. Bar supports hold the crossband bars in place and at the proper level; special chairs are provided to space and support the column-head frame, and cross-spacing bars hold the rectangular bands in proper position.

How the Steel Is Put in Place

The steel is laid as follows: First, lay the rectangular bands, supporting and securing each band by means of three spacers. Then lay one diagonal band, and as fast as the other diagonal band is laid over the top of this one, put in three lines of bar supports. These supports hold the bars up the proper distance from the forms and tie the two bands together. Next, place the cast-iron bar chairs around the column head, and nail to the formwork. Then lay three of the column-head bars over these cast-iron chairs. Next, lay one complete band of column-head steel over these three supporting bars, and wire it to the supporting bars. Finish by laying the balance of the column-head steel parallel to the three supporting bars and wiring in place; also wire to column bars. The three supporting bars first placed over the cast-iron chairs are included as part of the column-head reinforcing in that direction.

It is also possible, and on large jobs advisable, to assemble the column-head reinforcement into units on the ground. The units may then be hoisted as required by means of a derrick and be placed in proper position over the column heads. This reduces the length of time required for placing steel after the formwork is completed.

For large panels and heavy loading, all bars will be $\frac{3}{4}$ in. or over, thus avoiding all "size extras." Floor slabs will usually require $\frac{5}{8}$-in. bars for the panels and $\frac{3}{4}$-in. bars for column heads. Roof slabs will usually require $\frac{1}{2}$-in. bars for the panels and $\frac{5}{8}$-in. for the column heads.

Some of the construction advantages of the system have been outlined about as follows by Eli White, who has been in charge of a number of buildings erected by the Wood company under the system.

In the use of the straight-bar system with an ordinary 20-ft. square panel the length of the bars varies from 11 ft. for top bars to 24 ft. for diagonal bottom bars. These lengths are readily obtainable from stock in any large city, which is an important item in these days when shipments of reinforcing steel are frequently delayed from one to two months by freight congestion. Furthermore, with the shorter lengths it is possible to wire together the various bands of reinforcing steel for typical panels, tag them and have them ready to hoist above into place.

Steel Easy and Cheap to Place

By keeping the bands together as units there is a large saving in the cost of placing: First, because these bands can be made up, while the forms are being erected, by the foreman of steelwork and an assistant; and when the time for placing comes, a foreman can direct the placing of the tagged bands very rapidly, using unskilled labor for this work. This is not possible where long lengths of bars are used, since with these longer bars the weight of a bundle making up one band would make the handling of a band as a unit impossible. Second, the shorter lengths do away with the trailing of long bars over the forms with the consequent interruption to carpenters and other trades and disturbance of inserts, pipe sleeves, etc., caused by handling bars in this way. By the use of the shorter length of bars it is possible for steelworkers to follow very closely behind the carpenters, as the bars do not project from one panel into the next and steel can be placed as fast as forms are completed, without interfering with carpenter work. The top bars are made up into mats and handled as such.

By the use of separate top-bar mats, laborers may be employed in placing bottom steel before column steel is in position. As rapidly as the bands of bottom bars are placed, they are secured with bar spacers that accurately locate the bars in horizontal position and support them the proper distance above the forms. By the use of the separate top-bar mats it is not necessary to place these

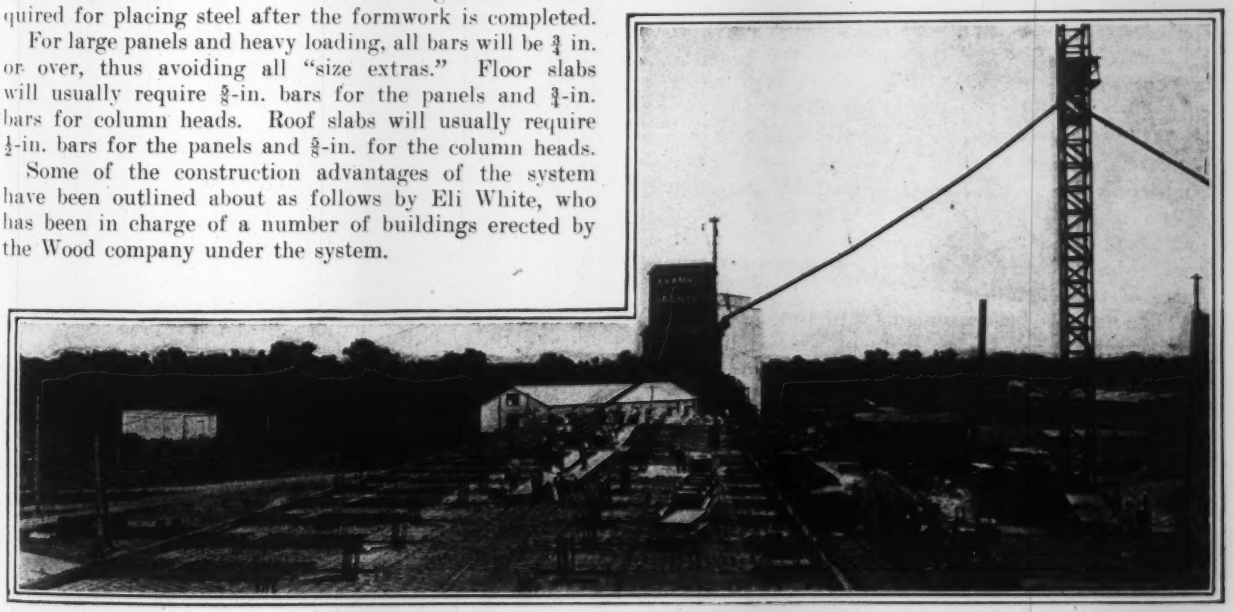


FIG. 3. FLOOR STEEL IS JUST BEING PLACED FOR STRAIGHT-BAR FLAT-SLAB SYSTEM

until just before the slab is ready to be poured, so that there is no danger of bars being bent and thrown out of position by workmen.

It is claimed that the cost of the reinforcement is cheaper, because large-size bars—on which base price is low—can be used and because the cost of bending is obviated.

Fig. 3, giving a view of the Fort Worth building mentioned, shows the bars in position. The built-up mats of top bars are lying on the decking ready for placing. Fig. 1 is an interior view of another building. The cost of setting all reinforcing steel, including the bending of beam bars where such occurred and wiring of column stays and hooping, in the construction of the Fort Worth assembling plant amounted to $8 per ton; and this work was done entirely with unskilled labor under the direction of one foreman of steelwork.

Designing Methods for Straight-Bar System of Flat Slabs

Uniform Procedure of Design Developed from Theory and Applicable to Girderless Floors

By JOHN NYDEGGER

Engineer, W. E. Wood Co., Detroit, Mich.

IN THE study of the girder-floor slabs described in the foregoing article a method of procedure was developed that proved very successful. In connection with standard plates, reproductions of which are shown herewith as Figs. 4 to 7, the routine design has proved quite simple. The theory used is outlined herewith.

Assumptions of Load Distribution

Let L represent the panel length—that is, the distance center to center of columns for square panels, or the side of the equivalent square for rectangular panels. Let W represent the total load on one panel. The following empirical formulas, given by the Detroit building code, are assumed as accepted for four-way systems:

"The steel in the center of the panel shall be designed to resist a bending moment of $\frac{1}{25}\ WL$ for interior and $\frac{1}{22}\ WL$ for exterior panels. The steel so determined shall be divided equally between two rectangular and two diagonal bands and in the case of rectangular panels one-half of the steel shall be equally divided between the two diagonal bands, and the remaining half shall be divided between the rectangular bands in the proportion of the cubes of their lengths.

"The negative bending moment in 180° around the column capital—that is, the moment resisted by two rectangular and two diagonal bands at the supports—shall be taken as $\frac{1}{15}\ WL$."

Assuming that the above formulas are correct, or as nearly correct as we are able to get from the test data and theoretical analyses on hand at the present time, it will be interesting to study them graphically. Assuming that the action of the slab between columns is similar to that of a fixed beam, we have a point from which to start a graphical analysis. A beam fixed at both ends and uniformly loaded has a bending moment of $\frac{1}{12}\ WL$ at the support and $\frac{1}{24}\ WL$ at the center, making a total of $\frac{1}{8}\ WL$. The total moment from the above formulas is $\frac{1}{15}\ WL - \frac{1}{25}\ WL = \frac{16}{150}\ WL$. If we assume that S = the length of a fixed beam whose total moment equals $\frac{16}{150}\ WL$, we have $S = 0.86L$.

In other words, we have the point of support for the fixed beam established, not at the center line of the column, but at a distance of $0.07L$ away from the center line.

We may now lay out a section showing the moment curve, the end of the fixed beam and locating the point of inflection (Fig. 4). Having established the point of inflection, we have at once the length of the simple beam suspended at the points of inflection. Note that this length is $0.54L$ for interior panels and $0.58L$ for wall panels.

We may now establish the width of a beam whose length is $0.54L$ and which is loaded with the design load and whose moment, figured as a simple beam, will be the same as the moment for one band of bars figured by the empirical formula. This width equals $0.28L$.

Following out a similar line of reasoning for the diagonal beams, we may now draw a diagram as shown in Fig. 4, which shows graphically the difference between the empirical formulas and a beam system. Beam A is a simple beam, whose length and width were established as described above. When loaded with full floor load it will give a bending moment equal to that determined by the empirical formula for one band. Beam B is a simple beam which, when loaded with half the floor load, will give a bending moment equal to that provided by the empirical formula for one band of bars.

Since the two diagonal beams cross, the area covered by the two beams in common will get full floor load. This beam diagram leaves in each panel four triangular areas H whose floor load is not accounted for; and for the ends of the diagonal beams, only half the floor load is accounted for. The areas inside the line of inflection will be accounted for when figuring the negative moment.

The areas H and the ends of the diagonal beams that take only half the floor load illustrate graphically the difference between the empirical formulas and the beam system, were the slab to be cut through on the lines indicated, so as to act as simple beams.

How the Method is Applied to Typical Case

To illustrate by a concrete example, assume a panel 20 ft. square, with 300 lb. total load per square foot. By the empirical formulas we have:

For wall panel,

$$20 \times 20 \times 300 = 120{,}000 \text{ lb.},$$

$$M = \tfrac{1}{22} \times 120{,}000 \times 20 = 109{,}000 \text{ ft.-lb.}$$

Moment for one band of bars $= 109{,}000 \div 4 = 27{,}300$

For interior panel,

$$M = \tfrac{1}{25} \times 120{,}000 \times 20 = 96{,}000$$

Moment for one band $= 96{,}000 \div 4 = 24{,}000$ ft.-lb.

For column head,

$$M = \tfrac{1}{15} \times 120{,}000 \times 20 = 160{,}000$$

Moment for one band $= 160{,}000 \div 2 = 80{,}000$ ft.-lb.

From the beam system laid out in Fig. 4, we have:

Beam A,

$$0.58 \times 20 = 11.6 \qquad 0.28 \times 20 = 5.6$$

$$11.6 \times 5.6 \times 300 = 19{,}500 \text{ lb.}$$

$$M = 11.6 \div 8 \times 19{,}500 = 28{,}280 \text{ ft.-lb.}$$

By the same procedure Beam $B = 28{,}280$ ft.-lb., Beam

D = 24,400 ft.-lb. and Beam E = 24,300 ft.-lb. The column-head moment works out to be 81,500 ft.-lb. The results obtained by the two methods are practically the same, the slight difference occurring only because the length and widths of the beams were not carried farther than two decimal places.

How Beam Diagram is Helpful

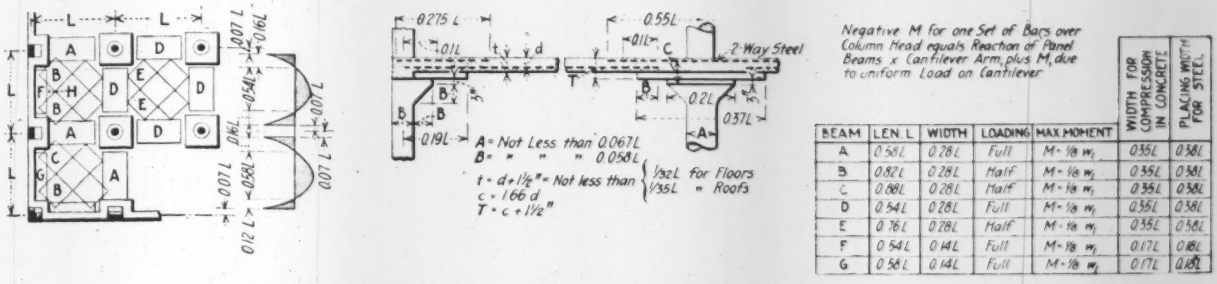
The reader may now ask what has been gained by devising a beam diagram that gives the same results as the empirical formulas. Certainly, the original formulas are easier to apply than the latter. We have gained two things: First, we have shown graphically to what extent flat slabs depend upon arch action, plate action or anything other than simple beam action; second, we have established a foundation from which to start, when it is necessary to deviate from the construction to which the empirical formulas are applicable.

For example, the empirical formulas imply that the wall columns shall have brackets and depressed heads; but if we wish to omit the depressed head or the bracket, or both, the empirical formulas do not apply. It is evident, however, that if we wish to omit the depressed head at wall columns and retain the bracket, we may do so by increasing the length of beam A (see Fig. 4) and decreasing the cantilever arm at the wall column. The most economical design will of course be obtained when the negative moment at the wall column is equal to the positive moment at the center of beam A, because, with the depressed head omitted, the slab is the same thickness at both points. The same line of reasoning applies when both bracket and depressed head are omitted.

When the outer edge of the slab is to be wall bearing, as is often the case with first-floor slabs, it becomes necessary to decrease the negative moment to zero and make beam A extend to the wall, thus increasing the positive moment at the center of beam A.

For convenience in the drafting room these conditions have been put into data-sheet form, a few examples of which are here shown:

Fig. 4 shows data for square panels having brackets and depressed heads on wall columns. Fig. 5 shows a method for designing the wall columns, taking into account the bending moment from the slab. Fig. 6 shows a method for designing the interior columns, taking into account the bending moment due to unbalanced live-loads. Fig. 7 shows proportions for interior column heads, and notes to be observed when making changes.


Negative M for one Set of Bars over Column Head equals Reaction of Panel Beams x Cantilever Arm, plus M, due to uniform Load on Cantilever
2-Way Steel
A = Not Less than 0.067L
B = " " " 0.058L
t = d + 1/2" = Not less than 1/32L for Floors, 1/35L " Roofs
c = 1.66 d
T = c + 1/2"

BEAM	LEN L	WIDTH	LOADING	MAX MOMENT	WIDTH FOR COMPRESSION IN CONCRETE	PLACING WIDTH FOR STEEL
A	0.58L	0.28L	Full	M = 1/8 w_1	0.35L	0.58L
B	0.82L	0.28L	Half	M = 1/16 w_1	0.35L	0.58L
C	0.68L	0.28L	Half	M = 1/16 w_1	0.35L	0.58L
D	0.54L	0.28L	Full	M = 1/16 w_1	0.35L	0.58L
E	0.76L	0.28L	Half	M = 1/16 w_1	0.35L	0.58L
F	0.54L	0.14L	Full	M = 1/16 w_1	0.17L	0.18L
G	0.58L	0.14L	Full	M = 1/16 w_1	0.17L	0.18L

FIG. 4. GENERAL LAYOUT FOR ANALYSIS OF SQUARE PANELS

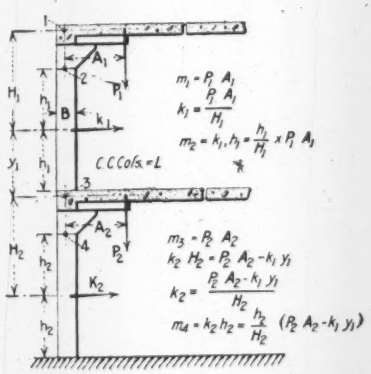

CC Cols. = L
$m_1 = P_1 A_1$
$k_1 = \frac{P_1 A_1}{H_1}$
$m_2 = k_1 h_1 = \frac{h_1}{H_1} \times P_1 A_1$
$m_3 = P_2 A_2$
$k_2 H_2 = P_2 A_2 - k_1 y_1$
$k_2 = \frac{P_2 A_2 - k_1 y_1}{H_2}$
$m_4 = k_2 h_2 = \frac{h_2}{H_2} (P_2 A_2 - k_1 y_1)$

FIG. 5. DESIGN OF WALL COLUMNS

1. P_1, P_2, etc., are composed of the reactions of the panel beams plus half the uniform load on cantilever. 2. B must be not less than 0.058 L. 3. Design column section for direct loading; fc = 500 lb., fs = 7500 lb. 4. Compute moments M_2, M_4, etc., as indicated above. 5. Then add enough steel on each side of column to develop the moment, using (B — 3½) as a moment arm and fs = 18,000 lb.

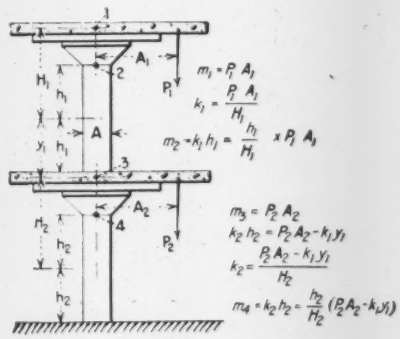


FIG. 6. DESIGN OF INSIDE COLUMNS

1. P_1, P_2, etc., are composed of the live-load reactions of panel beams plus half the uniform load on cantilever. 2. A must be not less than 0.067 L for round columns. 3. Design column section for direct loading. 4. Compute moments M_2, M_4, etc., as above indicated. 5. Compute steel needed for moment as follows: Denote this steel area by a; then ¾ a × 18,000 × ⅞ spiral diameter equals resisting moments = M_2, M_4, etc. 6. One-half of this area a is effective for direct loading also. Thus it is necessary to add only half of a to the steel computed for direct loading. 7. Do not use less than eight bars ⅞ in. square in a round column

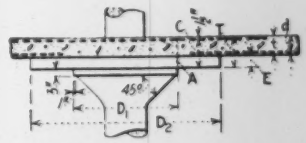


FIG. 7. DESIGN OF SLAB

When necessary or desirable, some changes may be made in head dimensions given on design sheets, but the following should be observed: 1. D_1 should not be less than 0.2 L for floors. 2. It may be reduced to 0.18 L for roofs. 3. D_2 should be 0.37 L, but may be reduced to not less than 0.35 L or may be increased to not over 0.4 L. 4. C must not be more than 1¼ × d, but there is sufficient shear area at A. 5. Shear at A must not exceed 60 lb. per sq.in. If necessary, change D_1 or C in order to keep shear below 60 lb. 6. For figuring shear at A, use only 80% of the live-load on the panel

FIGS. 4 TO 7. DESIGN STANDARDS PREPARED FOR READY COMPUTATION OF STRAIGHT-BAR SYSTEM OF FLAT-SLAB CONSTRUCTION

Hints for Army Camp Buildings in Contractor's Bunk Houses

Experience on Many Jobs Has Proved the Value of Certain Details of Frame Structure Design

In the hope that certain details of design may be utilized by the War Department in getting up plans for the training camp buildings, Frederick J. MacIsaac, of the firm of Smith, Hauser & MacIsaac, contractors, of New York City, has mailed to Washington plans of a construction bunk house which has proved eminently satisfactory on many large jobs. These plans are reproduced in the accompanying drawing.

Roof Detail Important

One of the special features is the connection between the sloping roof and the vertical side walls. It will be noted that there is very little overhang and that the use of a 2 x 12-in. plate along the top of the wall provides a pocket which carries the warm air from the interior of the building out under the eaves to the very end of the roof. In climates where ice and snow are to be expected, this detail, Mr. MacIsaac has found, is of very great importance. In the ordinary type of roof, with a long overhang, snow and ice is melted by the heat passing through the roof and freezes again on the overhanging portion of the eaves not warmed by the air from the building. The result is that great masses of ice and snow collect along the eaves, piling up so as to form a sort of gutter running the entire length of the building. This obstruction retains water flowing down the roof and eventually causes leaks. With the type of roof which has been used so extensively on Mr. MacIsaac's contracts, troubles of this kind are never encountered.

It has been found best to lay the planks for the roof and the side walls vertically. For this purpose 1 x 6-in. purlins are nailed to the rafters, and upon them the 1-in. roofers are placed and covered with 2-ply paper laid horizontally. With the roof timbers laid vertical, troubles from leakage are minimized. With the planks horizontal, however, ridges are apt to be formed in which water becomes pocketed and finds its way eventually through the roof.

A feature of the bunks, shown in the drawing, is that they are collapsible. By removing the carriage bolts, shown the frame may be dissembled for cleaning. All parts are made interchangeable.

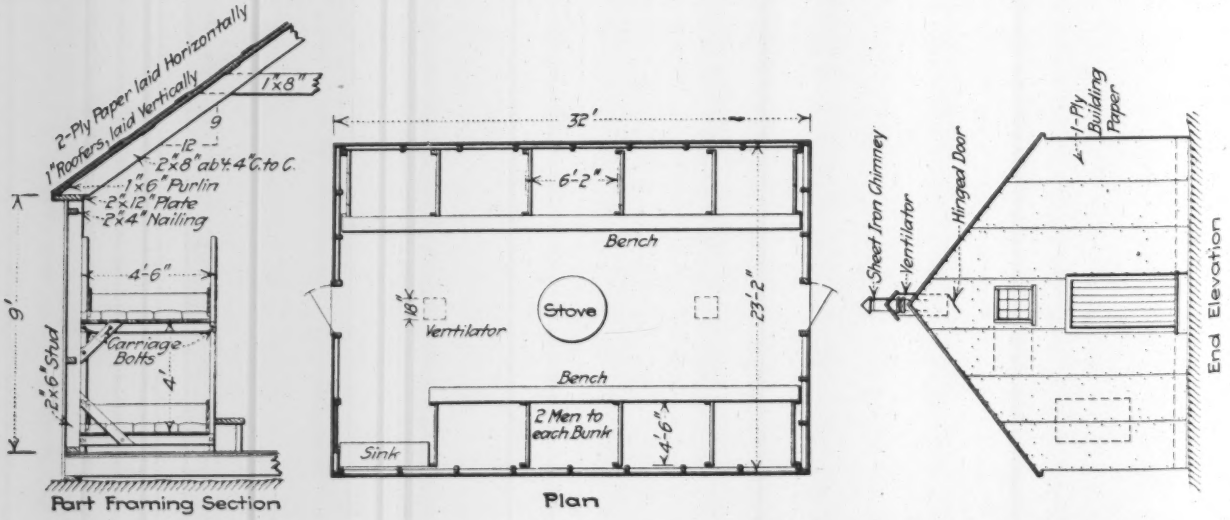
While the building shown has an overall width of 23 ft. 2 in. and an overall length of 32 ft., the length may be increased by one bunk section—6 ft. 2 in.—so as to leave room in one corner of the structure for a shower bath next to the sink.

The flooring of the bunk house consists of a bottom course of ¾-in. rough timber, laid diagonally, then 1-ply building paper, and upon this a 1-in. finished flooring. There are two ventilators in the roof, as shown in the drawing, and a sheet-iron chimney from the stove at the center of the room.

Mr. MacIsaac prefers the bunk house illustrated to one of larger dimensions. They may be built in groups with drainage facilities between each pair. The structures are cleaned periodically with chloride of lime. The fact that the bunks are collapsible makes them easy to wash with disinfectant.

Long-Sustained Temperatures Have Cumulative Effect on Water Consumption

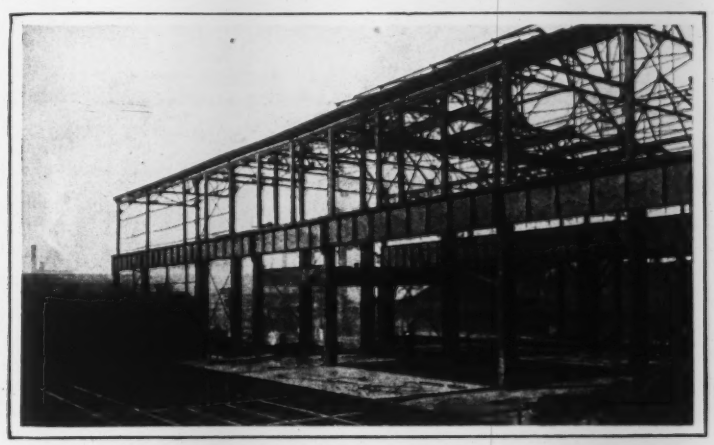
Water-consumption records were broken last summer in Denver twice and both times the peak loads came at the end of a sustained hot wave. Both waves were broken by precipitation, the consumption and temperature curves dropping simultaneously. On July 6 the total for a day was 75,000,000 gal. at the end of a continued rise in the minimum temperature for 6 days. Higher maximum temperatures had been experienced several times before. On July 28, 77,500,000 gal. were used, building up gradually from the previous maximum figure for 4 days, both as to minimum temperature and consumption. Previous maximum consumption figures were 72,200,000 gal. in July, 1913, and 70,600,000 gal. in June, 1914.



ONE OF THE FEATURES OF THIS BUNK HOUSE IS THE CONSTRUCTION AT THE EAVES, WHEREBY WARM AIR FROM INTERIOR PREVENTS FORMATION OF ICE RIDGES ON ROOF

Steel Plant Enlarged Under Difficulties

Scant Room To Set Up Plant and Store Material Used in Building Pile and Concrete Foundations for Additions to Steelton Works



HEAVY FRAMING IN EXTENSION TO FURNACE BUILDING

LARGE construction operations carried out in congested space and under difficult conditions mark the enlargement of the Bethlehem Steel Co.'s plant at Steelton, Penn. The existing blast furnaces, steel plant and rolling mills at the upper, or west, end of the property, with their tracks, already closely fill the available space between the Pennsylvania R.R. and the Susquehanna River on the one side and the town of Steelton at the foot of the steep hills on the other. Furthermore, the plant trackage and equipment are so heavily taxed in serving regular operation that a steady supply of construction materials could not always be maintained. Under these conditions the contractors have been obliged to work with small mixers, short, frequently moved towers and a hand-to-mouth supply of concrete materials, because there was no storage space available near the work.

Improvements Under Way Since 1906

The plant, until recently the Pennsylvania Steel Co., has been undergoing improvement since 1906. The additions at present under construction are part of a program that has been actively under way for some time. They include an extension to the openhearth and bessemer building, which will house a new bessemer converter and provide space for two 200-ton tilting openhearth furnaces, one of which is now being installed. This extension will also contain an additional 150-ton ladle crane of 65-ft. span. The ore storage and stock bins are being extended to the east to serve a new blast furnace, one of a pair, the first of which was blown in early this spring; an extension to the blowing-engine plant is being built; an extension that will double the capacity of the machine shop is under construction; and a 6-ft. diameter concrete sewer is being completed.

All this work is at the west end of the plant, which extends over a narrow strip of land some three miles long on the north bank of the Susquehanna River. At the east end of the plant, where the fabricating shop and the coke ovens are located, a battery of 60 new Koppers coke ovens, a byproducts building, gas-pumping station and other related work are under way. As this end of the plant is much less congested than the steel-making end, there is an opportunity for securing adequate storage for materials and using ordinary construction plant; and on that account the work has gone forward without interruption or unusual difficulties.

Concrete Piles Needed at West End

Slate rock at the site of the plant lies 18 to 20 ft. below the surface. Over it is a layer of gravel of varying depth above which to the surface, in the vicinity of the blast furnaces, ore yard and blowing engines, the soil is fine silt. On this account piles are necessary for these structures. The pits for the charging skips at the blast furnaces extend down into rock.

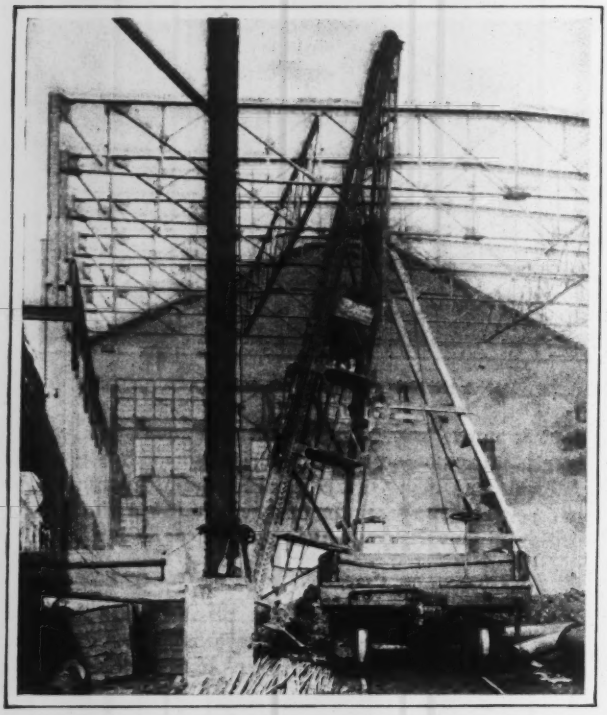
Some of the earlier portions of the plant were built on wood pile, but Raymond concrete piles are being used for the work now under way. There is considerable vibration to the gas-engine-driven blowing engines, which are large straight-line air compressors, delivering about 22,000 cu.ft. of free air per minute at 14 to 20 lb. pressure.

One of the five at present in use is mounted on vertical wood piles; three of the existing and the four new machines, however, are buttressed against vibration in the direction of the stroke by battering about one-quarter of the concrete piles in their foundations. These batter piles were driven in the same way as ordinary vertical Raymond piles by tilting the leads directly back on the driver frame.

On account of the fact that the new blowing engines are somewhat longer than those in use, and because there was not room to increase the width of the extension to the building, the foundations for them are set on a skew. These foundations were concreted by a spouting plant, the mixer of which was charged with wheelbarrows.

A similar plant was used for concreting the 300-ft. extension to the machine shop, and a third plant, with a tower about 50 ft. high, first completed part of the extension of the stock bins and retaining wall for ore storage back of the newest blast furnace, and then the foundation for this furnace itself.

When received at the plant, the ore that is to be used at once is dumped from a trestle into concrete bins on the furnace side of a concrete retaining wall parallel to and just north of the line of blast furnaces. As these bins hold only about one day's supply, ore is stocked over



BATTER PILES DRIVEN FOR ENGINE FOUNDATIONS

a storage space 1750 ft. long and 160 ft. wide, by two bridges handling 7½-ton buckets. Each has a clear span of 167 ft., with two cantilevers—one 52 ft. long and one 35½ ft. long—which respectively cover the ore bins and a track parallel to the yard on the side opposite to the bins. In a concrete tunnel under the bins is a track for the scale cars, which fill the large skips used to charge the blast furnaces. These cars are loaded from gates in the bottom of the bins. The latter can be filled either direct from cars or from the stock yard by the ore bridges.

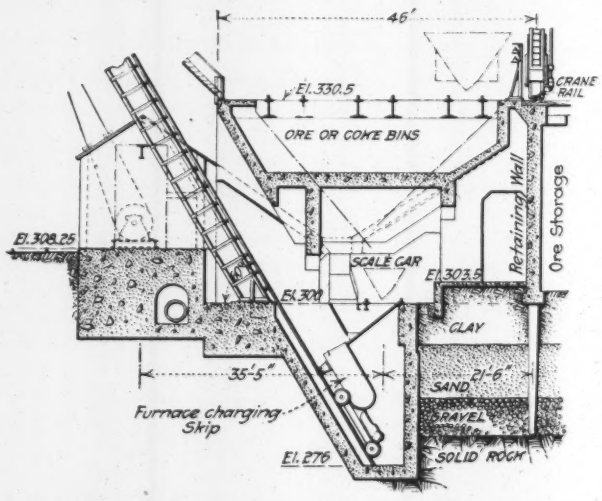
This system, together with the size of the large skips used to charge the furnaces, makes it necessary to extend down through a water-bearing stratum of gravel into rock, the pits into which these skips descend to be loaded. The pit for the newest blast furnace, which has just been completed, was constructed inside a steel sheet-pile cofferdam. The track for handling slag from the blast furnaces runs between this pit and the foundations for the new furnace, and just north of this track on the south edge of the cofferdam was set a ¾-yd. mixer that was supplied by wheelbarrows with material unloaded by a locomotive crane.

The pit was concreted from this set-up by direct spouting. Here, as at the other points in the western end of the plant, there was no room to erect charging bins over the mixer; and there was no opportunity to use a track mixing plant, because all the tracks are in constant use and room for constructing additional sidings is lacking. The space around this pit is now being backfilled by a crane, and a small spouting plant will be erected for completing the retaining wall back of the pit and concreting the approach trestle.

Between the western end of the plant and its main line tracks the Pennsylvania R.R. owns a low strip of right-of-way, which is being filled with slag and other mill wastes, furnished largely by the Bethlehem Steel Co., and on which the railroad will build a yard, mainly for handling the traffic to and from the steel plant. As the plant is being reconstructed, the general level is being raised to bring it to an elevation about 20 ft. above low water, as under present conditions extreme floods interfere with the operation of the plant and its railroad system. An extensive rearrangement of the tracks in this system is planned, which will include a new concrete approach trestle to the ore storage connecting directly with the new yard that the Pennsylvania R.R. will build, and considerably shortening the haul of ore within the plant. Also, a direct switchback connection between the blast furnaces and the steel furnaces will be established.

Large Concrete Sewer Required

The plant is supplied with water from a pumping station at the east end, which it is proposed later to enlarge. A section of the old Pennsylvania canal, which parallels the plant, has been converted into a distribution system. A large share of this water is used at the western end of the plant and there returned to the river. As part of the improvements to the water system, a concrete sewer is being constructed to take care of general drainage and a part of this return. Most of this work was carried out under the same difficulties as the foundation work, a one-bag batch portable mixer having been used to concrete the sections within the limits of the plant. However, a straight stretch 400 ft. long between the south edge of the property and the main line of the Pennsylvania R.R. was constructed with a cableway, which handled the exca-



PITS FOR BLAST-FURNACE SKIPS EXTEND INTO ROCK

vation and backfill and placed the concrete from a 1-yd. mixer.

The new battery of 60 coke ovens and the new quenching station at the extreme east end of the plant made it necessary to move over the coke track at the south side

of these buildings. Just here is a section of the old canal, which has been converted into a small settling basin. In order to clean this out at intervals, a small bypass canal had been constructed on its north bank. The change in location of the coke track necessitated moving a part of this bypass so far south that it had to be replaced by a concrete flume. In order to accomplish this, the settling basin has been emptied, the bypass used for operating the plant and the new concrete structure built in the north side of the settling basin. For this work and also for the foundations of the new ovens and quenching station, a portable steel-tower concrete plant mounted on a railway car is being used. The plant is similar to that described on page 703 of the *Engineering Record* of Dec. 9, 1916.

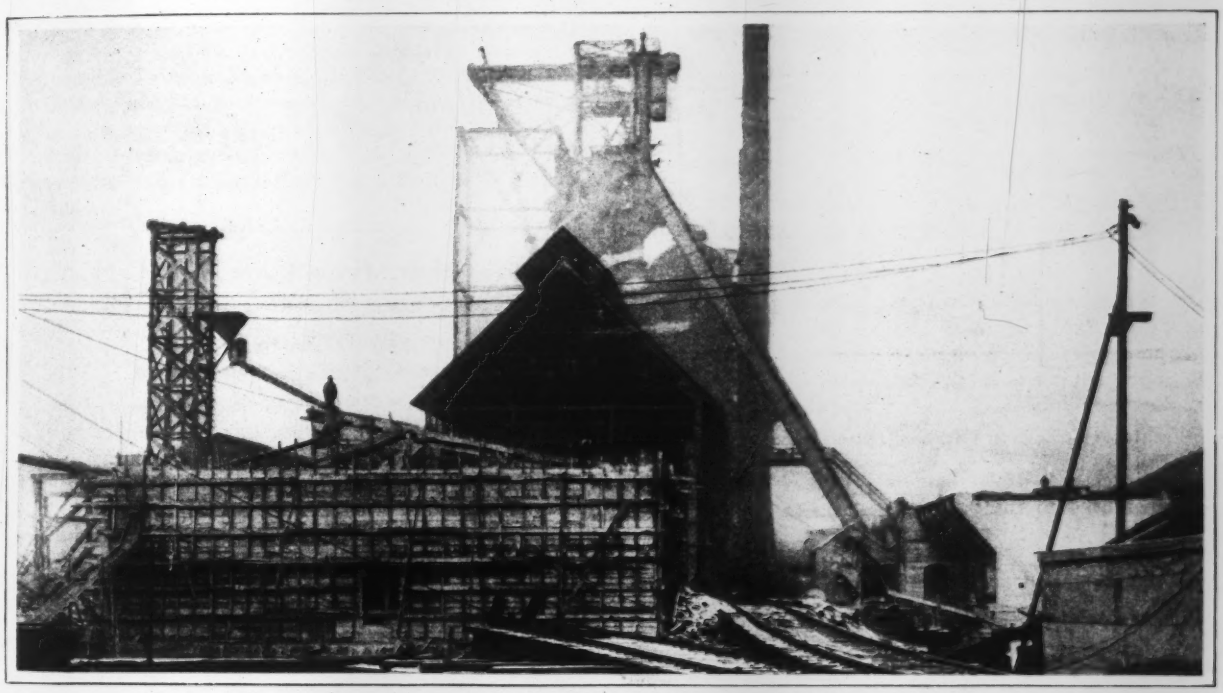
The foundations for the ovens are cellular, with a heavy concrete mat on the bottom resting on gravel, concrete side, end and cross walls and a reinforced-concrete deck. The spaces in this foundation are being backfilled with burned molding sand.

The byproducts building and gas-pumping station under construction lie north of the coke plant in a considerable open space between the ovens and the fabricating plant, where it was possible to carry on the construction work without interference. A stationary concrete-chuting plant with charging bins and room for some storage on the ground was set up near the east end of this site, where materials can be most readily received. The excavations for the outside walls and inside column footings, which rest on gravel about 15 ft. below the present surface, were first made.

This material, like that from the site of the ovens and from the work at the other end of the plant, was handled by locomotive cranes and disposed of in making fills. The walls were then concreted, and excavation is now being made for the machinery foundations inside the building. This spoil is piled around inside the area of the building and will be just about sufficient to backfill the space under its floor. The concrete work at the east end of the plant, excluding the gas-pumping station, which has not yet been begun, amounts to approximately 12,000 yards.

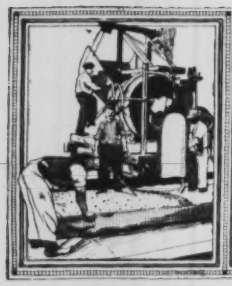
The Bethlehem Steel Bridge Corporation is fabricating and erecting with locomotive cranes all the structural-steel work, including the new blast furnace. The new ore bridge has been erected and placed in service; work is practically completed on the extensions to the steel-making plant and to the machine shop and is starting on the erection of the new blast furnace. The extension to the gas-blowing-engine plant is also ready for steel erection.

All brickwork, except that on the coke ovens, and all machinery installation are being carried on by forces of the Bethlehem Steel Co. Because improvements have been under way for some time and because furnace relining is always in progress in any case, a good force of brick masons had already been organized by the Bethlehem Steel Co. This force will be able to take care of all brickwork, except that at the coke ovens, for which masons will probably be brought in.



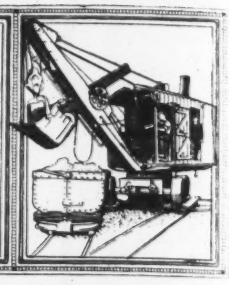
SHORT TOWERS MOVED OFTEN—NEW BLAST-FURNACE FOUNDATIONS

The improvement work at the Steelton plant is in charge of Quincy Bent, general manager of the plant for the Bethlehem Steel Co., and C. P. Turner, chief engineer of the plant. For the Bethlehem Steel Bridge Corporation, of which G. H. Blakeley is president, the erection is in charge of J. F. Ritter. The Raymond Concrete Pile Co., for whom J. F. Cavanaugh is superintendent, is constructing the foundation work at the western end of the plant, while the new coke ovens and other work at the east end of the plant are under construction by the H. Koppers Co., for whom C. J. Boe is in charge. The concrete sewer at the upper end of the plant is being built by the Whiting-Turner Construction Company.



HINTS FOR THE CONTRACTOR

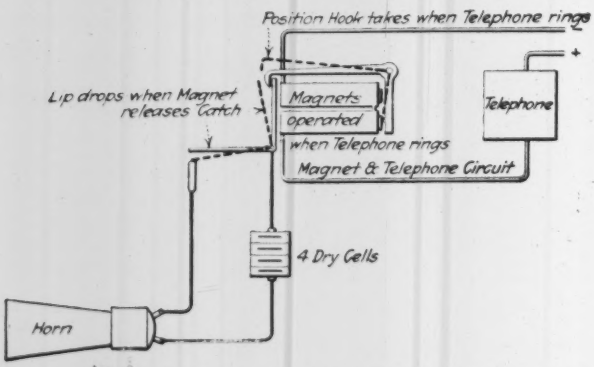
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK



Telephone Blows Auto Horn When Timekeeper Is Out on Work

By C. E. McCASHIN
Austin, Tex.

THE ARTICLE on p. 319 of *Engineering News-Record* for May 10 last, by Samuel Warren, describing the use of an automobile horn for calling men to the telephone, reminded the writer that he used a similar arrangement, which operated automatically, during the construction of the Gonzales dam, in Texas, for calling the timekeeper back to the office when he was down on the work.



SIMPLE RELAY MAKES TELEPHONE RING SOUND HORN

The office was situated on the hill; and when the telephone rang, the bell could not be heard unless some one were near it. An electromagnet similar to that ordinarily used in a call bell was placed in the telephone circuit, so that when the telephone rang the action of the magnet raised a latch that released a "lip," or drop. When this drop fell, it automatically closed a circuit in which a Klaxon horn was wired up with four dry cells. This circuit, of course, would remain closed, and the horn would continue to sound until someone came and put up the drop. The general arrangement is shown in the sketch.

At night, and when there was no one on the work, it was a simple matter to disconnect one of the wires and break the circuit, eliminating the danger of exhausting the dry cells in case the telephone should ring when no one was there to put up the drop. As the work was down in the river bed and some distance from town, there was no chance of confusing the signal with other automobile horns.

Eighteen-Man Mixer Crew Was Lacking, but Revolving Shovel Took Its Place

By DAY OKES
Of Hanlon & Okes, Minneapolis, Minn.

THE PHOTOGRAPH shows harvest season—no labor available—with 25,000 sq.yd. of base to be laid before an early contract date of completion. As a crew of 18 men was needed behind the mixer and as no such crew was available, a hopper of wood was built to discharge into the loading hopper of the machine, and the Erie revolving shovel shown was brought up to load the mixer—the job was finished on time.

STEAM SHOVEL REPLACES UNAVAILABLE 18-MAN CREW IN CHARGING PAVING MIXER ON RUSH JOB

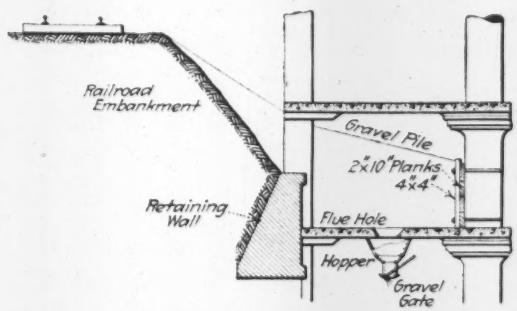
WHEELBARROW RUNWAYS REPLACED BY INDUSTRIAL TRACK LAID ON CARS IN RAILROAD CONCRETE PLANT

This work was done on a paving contract in Bismarck, N. D. This year the firm has purchased an auxiliary locomotive-crane boom and clamshell bucket and is using the shovel with this equipment to better advantage for the same purpose.

Favoring Conditions Used To Store and Handle Gravel at Low Cost

By F. H. VAN SAUN
Jersey City, N. J.

A BULKHEAD of 2 x 10-in. plank was erected across the first row of interior columns in the first floor of the four-story reinforced-concrete warehouse, built recently for the W. Beckers Aniline and Chemical Co.,



CONVERT FOUR BAYS OF BUILDING INTO GRAVEL BIN, HANDLING MATERIAL BY GRAVITY

Brooklyn, by the Turner Construction Co. In combination with a retaining wall on a railway siding along the building and with holes left in the floor for winter-weather heating, the bulkhead served to make a gravel-storage bin of 300 yd. capacity and to eliminate hand labor in loading the cars feeding the mixer. The arrangement is plainly shown in the sketch.

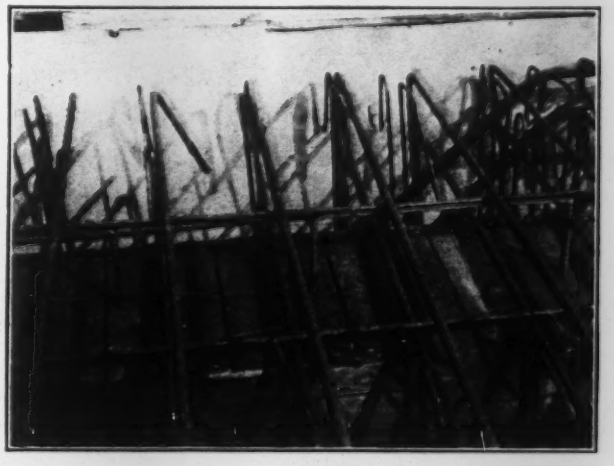
There were four of the chutes shown, one under the flue hole in the center of each of the four bays across the end of the building. The gravel, unloaded directly from cars into the bin, was drawn as wanted through these chutes by gravity into the cars.

Place Industrial Track on Top of Gondolas for Railroad Concrete Plant

THE PHOTOGRAPH shows some Rock Island gondola cars, permanently fitted with narrow-gage track on each side, carrying Lakewood cars for charging the mixer of a track concrete plant used on track-elevation work for the Rock Island R.R. in Chicago. Small bridges between cars can be taken out and replaced when the cars are shifted. It is necessary to take the cars higher than the tops of the gondolas to dump them into the mixer, which is accomplished, as shown in the photograph, by inclined tracks built on a flat-car coupled between the mixer car and the rest of the train. This track-elevation work is under the direction of R. M. Ford, engineer of track elevation, and A. Greenbaum, general superintendent of track elevation, for the railroad.

Bent-Bar Supports Hold Heavy Reinforcing Rigidly

A BOX SEWER, 10 x 20 ft., under construction on Dock St. in Richmond, Va., to replace an existing open channel, requires heavy top reinforcing for the



SUPPORT HEAVY REINFORCING BY BENT BARS

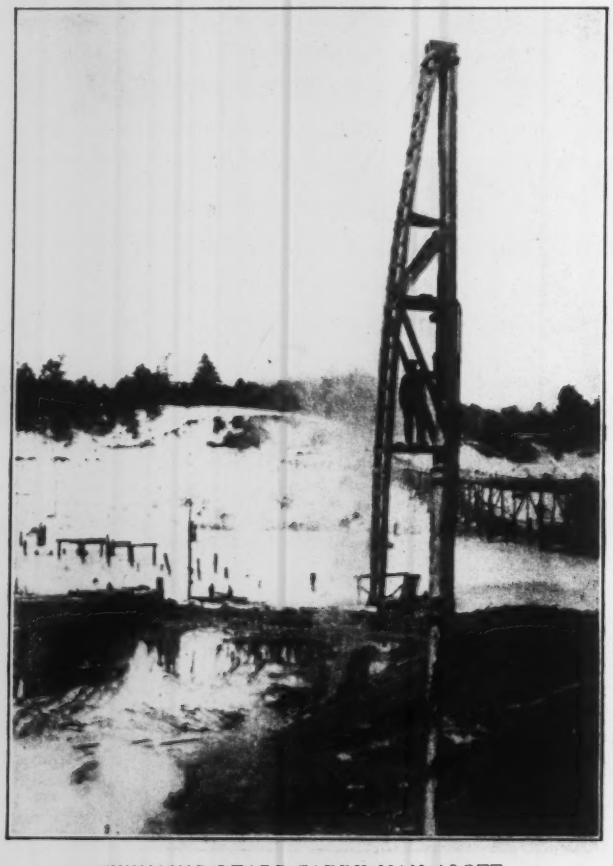
roof slab. To support this at the proper distance from the form, the contractors, Saville & Claiborne, use short reinforcing bars bent in the shape of a U and wired, legs down, under the steel. The method of support is strong enough to allow the concrete gang to walk around on the reinforcing without displacing it.

Shoot Load of Two-Inch Pipe Off by Stopping Truck Suddenly

A TRUCK driver carrying a load of 2-in. pipe to a subway contract in New York City recently was observed to turn his truck around where the pipe was to be unloaded, start it quickly backward and apply the emergency brake before the truck had traveled 2 ft. The load of pipe kept on going in the direction in which the truck had been moving and slid out onto the ground. "Dumping" the pipe in this way, which must have saved at least 15 min. time, was not very hard on the tires, as the truck was not going backward fast enough to slide.

Swinging Leads Built To Carry Man

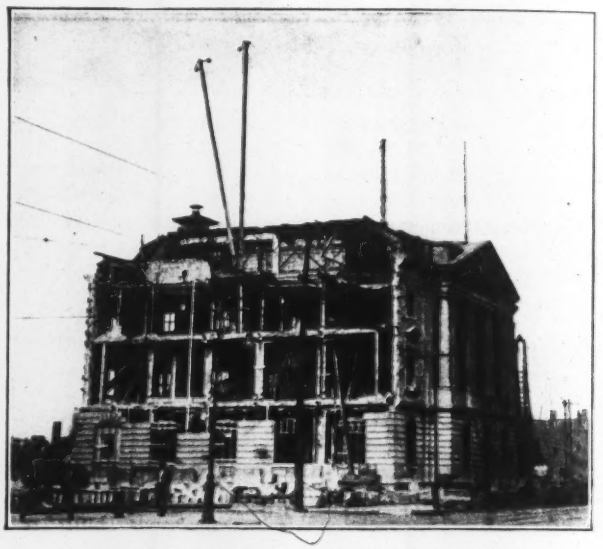
THE SWINGING leads shown in the photograph, built so a man can work aloft during driving, were used in constructing a new mill for the Northwest Paper Co.'s plant on the upper Mississippi River at Brainerd, Minn. It was necessary to drive some 60-ft. round piles in the river bank to support a conveyor 40 ft. above the river, and on this account the penetration was only 19 ft. As the steam hammer in driving never came nearer than 40 ft. from the ground, the type of leads shown was required. They were hung from an 85-ft. boom on a large derrick on top of the bank, 60 ft. above the river. Siems, Helmers & Schaffner were the contractors.



SWINGING LEADS CARRY MAN ALOFT

Remove Ends of Post Office with Derricks To Save Stone

THE END walls of the post office at East St. Louis, Ill., are being removed so that extensions may be built, the walls being taken down by derricks so as to save the stone for future use. For this purpose, as shown in the photograph, the contractor set up a large guy derrick on the upper floor at each end of the building. These booms reach all parts of the end walls. The hoists for both derricks are set on the ground. The wall stones are lowered by the derricks to low trucks, on which they are hauled to storage piles on the ground.



DERRICKS LOWER STONE TO DOLLIES

The work is being done by Farnesworth & Co. of Owensville, Ky.

String Drainage Tile on Gas Pipe Before Laying

By W. G. STONE
Consulting Engineer, Utica, N. Y.

AN ITALIAN foreman laying a 2-in. tile drainage line under the writer's observation in the foundation for some concrete curbing saved time and produced a better job by stringing several pieces of tile at a time on a gas pipe, laying them all at once. The 1½-in. length of pipe about 14 ft. long held the tile practically in place while they were chinked up with the gravel forming the drainage course, after which the pipe was withdrawn. This resulted in a much better and a quicker job than the usual method of handling each piece separately in the ditch.

EDITORIALS

Progress in Safe Building Control

BY UPHOLDING the certificate-of-occupancy system, a recent decision of the New York City Board of Appeals (on building-law matters) gives encouragement to progressive administration of municipal building control. The certificate of occupancy, while a new device, is an important instrument for making building laws give real and lasting protection. Without its help, building laws insure safety only so long as the originally intended occupancy continues, but do not prevent harmful conditions arising from change of occupancy. The public, however, is never aware of this limitation of protection. With the certificate plan, the limitation is removed. In the case in hand, the board could have negatived the application of the certificate clause in the city's building law without appearing to do so. Instead, the board stood for the strict application of the clause. The action is an encouraging precedent.

An Unexplored Phase of Secondary Stress

WHAT experimental knowledge we have of secondary stress in bridges relates wholly to live-load stress. It fails to tell us of total stresses or total secondaries. This deficiency is apt to be lost sight of when we read the figures that patient investigators and testers have brought together to show how much secondary stress exists in this bridge or that. It will not do to assume that dead-load secondaries are the same as those produced under live-load. They may be less; or they may be much greater, and may appear in different places. A few dead-load measurements have been made. The results are so far unpublished, and perhaps they are too few and fragmentary to make any real addition to bridge knowledge. But they are valuable as evidences that dead-load effects have not been left in complete neglect, and they support the hope that in time more complete study of stresses produced by dead-load will be made. For the present we have to bear in mind that secondary stress is nearly as much of an unexplored subject as before the live-load tests were made. We will have no really useful figures until many laborious sets of tests have been made to determine the amount of the dead-load secondaries and how the various practices of bridge erectors modify them.

Squeezing the Last Drop from Garbage

DICKENS' golden dustman might well turn green with envy if he could read of the new possibilities of revenue from city garbage opened up by the Columbus experiments recounted on page 534 of this issue. With slight if any reduction in the quantity and quality of grease and tankage, the experiments give fair promise of the potential production of large quantities of alcohol from every garbage-reduction plant in the country, and that, too, with small capital outlay and little addition to operating difficulties. The best is yet to be told. The alcohol thus produced, were the process satisfactorily applied to the garbage of all our large cities, would be equal in quantity to that produced from millions of bushels of grain or potatoes. City, state and Federal governments might well look into what may prove to be a double conservation—reclaiming city garbage wastes and conserving for food vast quantities of grain and potatoes now used to produce alcohol. If it is not all too good to be true, if this possibility proves to be a practicable reality, it may well be characterized as squeezing the last drop from city garbage.

Tell Others How You Overcome Your Troubles

LEARNING from failure has always been a common, if not favorite, practice among the best engineers. It is only natural to keep the resulting knowledge to one's self, but in late years engineers have shown a notable growth in courage or honesty, or possibly sense of duty, as regards the confession of their failures. Perhaps this is because they are learning that honest confession is good for the soul, and for the souls of brother engineers as well. Just as confession without repentance availeth not in morals, so in engineering a relation of failures or troubles without an account of how they were overcome is only half the story. Complete stories of difficulties and how they were met were so much a feature at the convention of the American Water-Works Association at Richmond last month as to give rise to favorable comment at the time. A whole series of such stories combined made up one of the best of the Richmond convention papers—in fact, one of the best papers ever presented before a technical society. This was the paper detailing incidents in the operation of the Minneapolis water-filtration plant, printed on page 538 of this issue. It will repay reading: By water-works men for the specific aid it will convey to them; by engineers in general as an exhortation to go and do likewise for the benefit of the profession at large.

Rivers and Harbors Not Military Necessity

THE United States War Department is now engaged in the prosecution of the very business for which it was organized—the conduct of a war. The offices at Washington are congested with men and with work beyond the conception of the most overworked business man. Every energy, every man, every bit of machinery in the department must and should be directed to a single end. In this emergency—one which was to be anticipated, else the War Department has no reason for existence—a large part of the effectiveness of personnel and administration must be devoted to routine office conduct not directly contributing to the progress of the war. Some of this is necessary. One function of the Corps of Engineers is not necessary, and in the light of present conditions is highly undesirable. That is the control of the river and harbor work of the country. While a

number of the officers normally engaged in river and harbor work are turning their attention to military matters and are being supplanted by retired officers who some time in the more or less distant past have had experience in such work, the routine of the work and its administration still devolve upon War Department heads and, worse still, on the Corps of Engineers. Thus, instead of having an eye only to the serious military needs a certain number of valuable executives must worry about civilian work, and the necessary red tape of administration must still trace its way through the 24-hour working day of the War Department at Washington. The advocates of a government bureau of public works will not fail to remember this, once the machinery of peace controls Congress.

Contract Inspectors Should Report to Engineers

WHY are inspectors employed to watch street paving and sewer work and other municipal contract work while under construction? Manifestly, the purpose is to insure that the work is properly done, and that the city gets what is intended and what it pays for. It follows that the inspectors should understand what good work is and how it is done and should know what are the requirements of the specifications concerning it. Manifestly, also, the inspectors should be under the direction of the engineers who are responsible for the design and construction of the work.

In not a few cities, however, these conditions do not obtain. Instead, there is a lax and ineffective system under which the inspection of work affords insufficient protection for the city or the taxpayers. This is due largely to the fact that the control of inspection has been taken out of the hands of the engineers and made a matter of local political control. Unfortunately for good municipal engineering practice, there has been a more or less prevalent custom of regarding the inspection of construction work as an opportunity for politicians (officials and others) to distribute personal and political favors and to pay off political debts.

Under such conditions the inspectors are apt to be men lacking in intelligence and character and having little or no qualification for the position. Even those who might be made competent find little incentive to exercise their ability, especially where the appointing power is in close and friendly relation with the contractor.

An old argument against placing inspection in charge of engineers was that, while the engineer is responsible for preparing the plans and making measurements, he has not sufficient practical knowledge to enable him to pass upon the methods and work of the contractor; hence, a "practical" man is necessary as an inspector. The falsity of this argument is obvious. But it is also pertinent to the subject to remark that the political appointed inspector is rarely a man of any "practical" experience in the work he is supposed to inspect.

The sound principle underlying the proper conduct of inspection in public-works administration is the same as that on which all administration is based: Responsibility must be clearly located from first to last, and must have adequate authority to support it. The engineer, who is responsible for the resulting structure, who predetermines the success of the final product by making the design, must also see that what is built shall agree with the design. To the readers of *Engineering News-Record* the truth of this statement needs no emphasis, but attention to it will enable many a public official to increase the success of his directive work.

A Way Engineers Can Get What They Want

NOT many weeks ago, mention was made in these columns of the victory of the engineers of Iowa over the legislative clique that designed to repeal the excellent highway laws of the state. It was not known, however, that at the same session these identical solons gave the bill for licensing civil engineers its death blow—so evening up a little score in the very stupid manner that has ever been the custom of parliaments. But they are not yet aware, are these "representatives" of the people, that in some peculiar ways engineers have a different attitude toward life and its problems than most people. Trained in science, engineers know that certain things cannot be done; these they leave strictly alone. On the other hand, they are continually being surprised that many things are not done; these the engineer will always tackle—beaten, will return to the attack. So immediately the Iowa senate voted 18 yeas, 22 nays, 10 absent or not voting, the legislative committee of the Iowa Engineering Society canvassed the roll call and circularized its members, suggesting that the favorable senators be thanked and the recalcitrant ones remembered against the coming of the next election.

It is a foregone conclusion that Iowa engineers will succeed in obtaining whatever it is they may want. They have learned the value of organization and clean-cut attack on single, simple issues. They are applying the rules of their profession to public affairs, and these early essays are showing them that what they can get is only limited by what they really want. A day will come—and that not far distant—when the Iowa example will be classic.

Railway Maintenance Affected by Labor Conditions

THE short supply and shifting character of labor, which is at present such a serious problem in the carrying on of construction work, affects also the maintenance-of-way work on the railways. In this case also there is added difficulty due to the low pay and uncertain employment of this department. Many roads whose section forces are recruited mainly from native labor living along the line, are trying to arrange for the more steady employment of these forces, so that by distributing the work throughout the year (and especially through the winter months) the gangs may be maintained at uniform strength and the men thus assured of permanent employment. Better pay and certain privileges are also being granted. In this way it may be possible to hold a good class of men at a reasonable rate of pay, even if the wages are somewhat lower than those paid on construction work where employment is temporary.

It is not sufficiently recognized that a good trackman is a skilled laborer, and that track work cannot be done efficiently or economically by green men. This is an important matter, calling for very careful consideration. In fact one of the weak points in railway maintenance-of-way has been the very general practice of cutting the track forces to a minimum at one time and then enlarging them at short notice to crowd work at certain times. Such periods often occur when other employment at higher wages is plentiful, and railways can then get only the inferior class of labor.

With extra or floating gangs, which cannot well be operated permanently, there is often difficulty in organizing and keeping the men, even if wages are somewhat higher than those of section labor. In this case, as in construction work, much depends upon the camp and housing accommodations and the management of the forces. However, the employment of permanent section gangs and the more extended use of machines and labor-saving apparatus should make it possible to reduce the amount of work which ordinarily has to be done by extra gangs.

Shall Public Utilities Do Without Dividends During the War?

DISCUSSING in constructive spirit the views presented in these pages recently under the title "Utility Managers and Commissions Face a Problem," a friend predicts that utility commissions will be found to meet the present abnormal situation fairly. He asks that the utilities themselves meet the emergency in a sane, businesslike manner.

It is quite clear that the getting together of utilities and commissions must be accomplished by both sides going halfway. This rule applies to all our present difficulties, and the case of the utilities is no exception. That is why our earlier editorial put the problem up to both sides equally.

This further statement of our correspondent is worth notice: "Facing the utilities, there is prospect of severe taxation. The underlying theory, however, is that the common people are to bear the brunt of dangerous service in the ranks, whereas capital is to carry the financial burden of the war. Should an increase in taxation by higher rates for utility service be transferred back to the public, and the financial interests keep on maintaining their customary dividends? If the general public is not to bear both the physical and the financial burden, is it not to be expected that there must be some decreases in the net earnings of utilities?"

The actual problem in many cases is to make such adjustment of rates as will prevent bankruptcy, and to make the adjustment quickly. Going on the principle that business continuity requires the solvency of business to be maintained, the line of zero profits is a dead-line on which anxious attention ought to be focused.

There is one other thought which commissions have a tendency to forget—that capital and the public are not two separate entities, but rather that capital is part of the public. The inclination to shear dividends should be tempered by remembrance that included among those who bear arms for their country will be found many whose families will suffer from the reduced dividends.

Mobexpertocracy Fails To Win Over Technical Study

MOBEXPERTOCRACY is a coined word meant to denote government by heterogeneous bodies of citizens who unite to defeat or postpone meritorious public improvements or reforms of which they know little, but imagine they know more. No matter how carefully such improvements or reforms have been planned by competent public officials, or what or how many real experts have guided the planning, the extra-legal, self-constituted, ever-shifting mobexpertocracy sets up its objections. If mobexpertocracy stopped with objections, it would accomplish comparatively little; but it sidetracks and occasionally wrecks meritorious projects by its hydra-headed confusion of counsels.

Such destructive influence is responsible for the years of delay in obtaining a pure water-supply for Sacramento, Calif., in place of the present seriously polluted supply. More than one expert report has been made for that city recommending a new water-supply; but nothing has ever been done toward carrying these reports into execution. It is gratifying to note, however, that a committee appointed by the local Chamber of Commerce recently became disgusted with mobexpertocracy and recommended that the subject be intrusted to technical experts for decision.

A public hearing of the committee brought forward excellent illustration of the nature of mobexpertocracy. Various citizens discoursed at length on the virtues of a mountain source of supply, a well-water supply, and a filtered river supply. The fruitless, unenlightened discussion did not mislead the committee, however, but brought it to the conclusion that the advice of laymen on the subject was valueless and that the problem could be solved only by water-supply engineers. The same conclusion might have been reached earlier.

One member of the committee declared that filtration had "been canvassed thoroughly by experts," but he then went on to urge that "experts look into the well and mountain supply idea." He quite overlooked the fact that the 660-page "Report on Possible Sources of Water-Supply for the City of Sacramento," by Prof. Charles Gilman Hyde, George H. Wilhelm, Consulting Engineers, and Frank C. Miller, City Engineer, made a year ago, discussed exhaustively both groundwater and mountain sources as well as filtration. He did not realize that the engineers had already provided the data for a decision.

Engineering News-Record does not undervalue the help to be obtained from intelligent public interest in engineering questions. On the contrary: By all means the force of public opinion should be brought to bear upon the settlement of public questions, but it should be an enlightened public opinion. Laymen should not try to qualify as experts on the strength of their own assertions, even if popularity or political chance has elevated them to an office that bears the label, Commissioner of This or That. The real expert should be given his place—and should keep in it, too—without attempting to usurp the functions either of policy-determining bodies or of the people whom such bodies represent. Under such conditions the real expert will come into his own, and there need be no fear of mob-expertocrats.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors will be Welcomed

Women Draftsmen

Sir—Permit me to reply to the letter of C. E. Newell, of the Southern Railway Co., regarding the employment of women in drafting, as published in the May 31 issue, page 169.

It is a good thing, for it will help cut down the costs of drafting for the various firms and corporations needing it, by the fact that women will work for less than men do; second, it will cause men now employed in drafting to look for other work in the engineering field, thereby crowding those more than they have been in the past, and thereby lowering the wages in those fields.

The following advertisements, taken from *Engineering News-Record* of May 31, 1917, and the Charleston (W. Va.) *Gazette* of June 1, 1917, speak for themselves and show the relative standing of civil engineers and day laborers:

> Three division engineers wanted for highway work at $125 per month; must have had experience in highway location and construction. Also four assistants at $65 to $90 per month. Work in West Virginia. Give full information, experience in detail, reference, when you can begin work, in first letter. Address P898 (Pa.) —Eng. News-Record, Phila.
>
> Day laborers, $3 per day of nine hours; board on property, $6.50 per week. Apply Foreman & Putnam, contractors, Cabin Creek Junction, W. Va.

JOSEPH WEBB,
Richmond, Va. Chesapeake & Ohio Railway.

Thick vs. Thin Bituminous Carpets

Sir—I have read the article on p. 154, *Engineering News-Record* of May 31, entitled "Best Results Not Obtained with Thick Bituminous Carpets." The conclusions drawn in that article indicate that cold-oil applications covered with sharp sand should produce the best result. My experience has shown me that the application of ½ gal. of bituminous material applied hot to the clean surface of a broken-stone road and then covered immediately with a mixture of 50% of ¾-in. and 50% of ½-in. broken stone and thoroughly rolled produces a wearing surface of considerable merit and very pleasing and satisfactory to light motor-vehicle traffic.

The bituminous material is such that, when evaporated in the open air at a temperature not exceeding 500° F. until the remaining residue has a penetration (5 sec. 77° F., No. 2 needle, 100 g. weight) of 10 mm., the amount of such residue shall not be less than 85% nor more than 95% of the original oil. At a temperature of 77° F. such residue shall have a ductility of at least 25 cm. (Dow mold).

The method of cleaning I personally advocate is as follows: The road is first cleaned by a mechanical broom and then by steel handbrooms. This removes the dust that settled back on the road in the rear of the mechanical sweeper and also removes particles that were not removed by the sweeper.

The application of light asphaltic oil applied cold has its merits. If the road is first treated with an application of the light asphaltic oil and sand, and then, after six or twelve months' travel has ironed and consolidated this application, the heavier material is applied, better results are obtained. This is probably due to the fact that the light surface treatment can be more thoroughly cleaned.

The application should be made uniformly, and this can best be accomplished by using the automobile pressure distributor. Only sufficient pressure should be carried to make an even distribution. The stone should be applied immediately and uniformly. The best results are obtained when the ¾-in. stone is applied first and the ½-in. later. These roads have a tendency to bleed at times, and the places where the bleeding occurs are covered with sharp sand.

To obtain best results, first thoroughly clean the road—and it cannot be too clean. Second, apply the material uniformly upon the dry, clean surface. Third, apply graded broken stone. Fourth, roll until thoroughly compacted. Fifth, never attempt to obtain good results where the road surfaces are rutted or contain depressions. The surface should first be repaired and patched with some cold patching material until there is a uniform cross-section. This treatment will not withstand heavy automobile trucking, but is suitable for pleasure vehicles.

JAMES LOGAN.
Mount Holly, N. J. County Engineer.

Engineers for Engineering Work

Sir—Referring to the editorial, "Engineers for Engineering Work," in *Engineering News-Record*, May 24, 1917, p. 1117, I desire to make a few statements which may reflect a little more light on this subject.

1. The Construction and Repair Division of the Quartermaster Department has *not* as yet "been reduced almost to the state of helplessness by the sudden load which has been placed upon it."

2. From all reports thus far obtainable, the Quartermaster Department has responded very ably to the first call for providing shelter and living comforts for the vast army now being assembled, and this department deserves great credit for the results thus far obtained.

3. The Quartermaster Department is trying, and always has tried, to produce the greatest benefits for the least expenditure, and we believe that it has been repeatedly shown that this department, with its able personnel, has been capable of producing the above results.

4. I feel confident that there is not, nor has there been, any interoffice jealousy regarding the work assigned to the Quartermaster Department, or assigned to the Engineering Department. Both departments have very able men at their heads and among their personnel, and it would seem the height of folly during the present crisis to even suggest that these men would consider such an unpatriotic condition to exist when coöperation among all the branches of the War Department, as well as the various other Government departments, is required.

5. There have been in the personnel of the Quartermaster Department approximately 60 civil, mechanical and electrical engineers, who advise and assist the officers detailed for construction and repair work. New construction and extraordinary repair work are very irregular, and

therefore I feel sure that the Department has tried to keep its personnel of regular engineers down to a minimum, and as the emergency arises, due to increased volume of business, additional engineers are employed temporarily until the emergency is past. The ordinary repair work is regular and constant, and most of this work is now done by the enlisted personnel of the Quartermaster Corps, with the assistance of such civilians as are required. The statement, "instead of being under the control of the Corps of Engineers the work is handled entirely by the Quartermaster Department, which, it is understood, has extremely few engineers in its personnel," may be very misleading to those not familiar with the Quartermaster Department work. If this statement is construed to mean extremely few engineers to do efficient work, it will surely give the wrong idea of actual conditions. We believe the results that have been attained by the Quartermaster Department should be a great credit, both to the civilian engineers, who have tried to do their utmost to make the Quartermaster Department work a success, and to the officers detailed for construction work, who have tried to produce results at small expense. Our only hope is that the efforts of these civilian engineers (many of whom are members of the American Society) have been appreciated and that, when opportunity offers, their faithfulness and strict attention to duty may be rewarded.

6. In conclusion, I would say that it is very inopportune, at the present time, to even suggest a change in the method of controlling the construction and repair work as now assigned to the Quartermaster Department. As competent engineers, it should make no difference from whom we are to receive our orders, whether an officer of the Engineer Corps or the Quartermaster Corps, because at best we can only give our personal opinion and do as our education and practice dictate, leaving it for our superiors, who are responsible, to make the final decisions. I would therefore suggest that all engineers put aside their personal feelings at the present time and, whenever and wherever possible, put in a good word instead of a criticism. Being human, we all have our failings, and no organization is so perfect that it cannot be improved upon. One and all, we should work for the common cause—namely, engineering success and a perfect and undivided Union in the present struggle with our enemies.

JOSEPH BAYER,
Civil Engineer, Quartermaster Corps.
Fort Sam Houston, Tex.

Vehicular Tunnel Under Hudson

Sir—In the article, "Tunnel Under Hudson Designed for Vehicular Traffic," published by you in the issue of Apr. 19, p. 132, it is stated: "The sectional method of tunnel building shown in the illustration has been employed successfully in the construction of the Detroit tunnel and of the new subway tunnel recently constructed under the Harlem River for the Lexington Ave. subway."

This statement is not only misleading, but not in accord with the facts. The method proposed for the Hudson tunnel is to prepare a pile foundation in a trench dredged in the river bottom, as was done in the construction of the Harlem River tunnel at 145th St., and then place upon it a portion of a precompleted tunnel, whereas both at Detroit and in the Lexington Ave. tunnel, forms of a working chamber were lowered upon a preliminary foundation, then the walls of the working chamber were built by depositing concrete in the water through tremies, then the working chambers were unwatered and the tunnel proper built in place within them, as was done in the construction of the Hudson River tunnel at 145th Street.

New York. DUNCAN D. MCBEAN.

[On p. 80 of the "Report to the Executive Committee of Public Service Corporation of New Jersey on the Proposed Vehicular Tunnel Between the Cities of Jersey City and New York" appears this statement: "Quite similar procedures have been employed successfully in the construction of the original subway tunnel under the Harlem River and of the Detroit tunnel and, finally, of the new subway tunnel recently constructed under the Harlem River for the Lexington Ave. subway."—Editor.]

War Status of Imhoff and Other German Patents

Sir—On account of the war, and in strict accordance with the spirit of the times and after careful consideration by our attorneys, who have advised us, as well as the Department of State in Washington, regarding this matter, we have decided to make a public statement regarding our connection with Dr. Karl Imhoff, of Essen, Germany.

As the Imhoff tank has been extensively specified and used and will still further be used, the accompanying circular letter of May 24 should prove interesting to your subscribers. S. FISCHER MILLER, President,

New York City. Pacific Flush Tank Co.

[The circular letter in question follows.—Editor.]

To those interested in the right to construct or use the patented tank of Dr. Karl Imhoff, of Essen, Germany, United States patents, June 5, 1909, No. 924,666; Dec. 20, 1910, No. 978,889; Feb. 18, 1913, No. 1,053,396; Mar. 25, 1913, No. 1,056,548; Mar. 25, 1913, No. 1,057,154.

Dear Sirs—Since the introduction of the Imhoff tank in 1911 for sewage treatment in the United States, we have been the commercial representatives for Dr. Karl Imhoff in the matter of collecting royalties under his patents and in the distribution of literature, etc., relative to such patents.

Our relations with Dr. Imhoff since their inception have been very friendly, but the present war has placed us in a somewhat embarrassing position which, it seems to us, calls for an explanation to those interested.

The war with Germany prevents us from remitting further royalties to, or in any way communicating with, Dr. Imhoff, who has become an alien enemy. This being the case, we have asked our Chicago attorneys, Mayer, Meyer, Austrian & Platt, for an opinion as to the proper course to pursue in handling the matter until Dr. Imhoff, or his heirs and assigns, can be legally communicated with.

While the law forbids communication with an alien enemy during the war, it probably will not abrogate the ultimate rights of such alien enemy; and although we cannot at present transmit royalty fees to Dr. Imhoff, his right after the war to collect such royalties will in all probability be the same as if the war had not existed.

In order to protect those who are using or may in the future use the Imhoff tank for sewage treatment, we have decided to deposit with the First Trust and Savings Bank of Chicago in a special trust fund all moneys received by us for account of Dr. Imhoff after date. This fund will remain in trust until commercial relations with Germany may be legally resumed. For funds so paid we shall furnish a receipt and a certificate from the above-named bank that said funds have been deposited with it in trust. In cases where no license has as yet been furnished by Dr. Imhoff, these funds received by us since the President's proclamation will be held in trust by the bank until such a license has been received from him, his heirs or assigns, or until otherwise legally disposed of.

We submit the foregoing explanation of our position to those who contemplate building or who have let contracts for Imhoff tanks or who have already completed the construction, but have not paid a license fee. The following table shows the royalty fees as heretofore prescribed by Dr. Imhoff, said fees being based upon the population ultimately to be served.

Pop'l'ation	Fee	Population	Fee	Population	Fee
100	$10	2,500	$155	15,000	$590
200	20	3,000	180	20,000	750
300	30	3,500	200	25,000	850
400	40	4,000	220	30,000	1,000
500	50	4,500	235	40,000	1,300
600	58	50,000	255	50,000	1,500
750	65	6,000	290	75,000	2,100
1,000	80	7,000	325	100,000	2,550
1,500	105	8,000	360	200,000	4,300
2,000	130	10,000	430	350,000	6,800

Our plan, we believe, will enable contractors to complete their contracts, pay royalties and secure their release, and at the same time protect all cities or others desirous of using the Imhoff tank. In this connection we wish it distinctly understood that in suggesting this plan we assume no personal liability or responsibility other than herein disclosed.

Pacific Flush Tank Co.,
S. Fischer Miller, President.

[A letter from Clyde Potts, discussing the general subject of royalties on patents held by or for Germans, and containing conclusions similar to those reached by the above-signed company is appended.—Editor.]

Sir—There has been considerable discussion among engineers as to the effect of the war with Germany on American patents taken out by German citizens. This applies particularly to Imhoff tanks and Reinsch-Wurl screens. To ascertain the exact situation with regard to these patents, I took the matter up with Henry C. Workman, an assistant attorney in the Department of Justice, and received a reply from him (which is purely his personal view) from which I quote:

"The patent situation in Germany is causing a good deal of unrest and uncertainty everywhere.

"A United States patent owned by or granted to a German subject is not affected by the war. It is as valid as ever it was. However, war puts a stop to all commercial intercourse between the citizens of the two countries, and the courts of this country are not available to a German to enforce his rights during the war. That is to say, a suit on a patent by a German citizen could not be prosecuted in this country against an infringer and an infringer could, therefore, not be enjoined. The suit could probably be revived after the war, but whether it would carry back to acts done during the war is uncertain.

"I have heard that in several instances bills have been introduced or proposed to cancel certain particular German patents. Some of these relate to drugs. I should say this was a bad policy, because Germany will be bound to retaliate and there is much capital and large business interests in Germany founded upon German patents owned by American citizens.

"Great Britain has adopted a policy with regard to German-owned British patents whereby the Government licenses anyone who wants to work the invention, collects the license fees and holds them in trust for the general settlement at the close of the war.

"I understand that Russia is the only country that took steps to confiscate German-owned patents, and Germany retaliated in kind. France has adopted, I believe, a similar liberal policy to Great Britain.

"There is proposed or pending a 'Trading with the Enemy' act, and it is intended, I believe, that this act shall contain clauses looking to the adjustment of the international patent situation."

Mr. Workman is the attorney who is handling the defense of the infringement suits against the United States by the Cameron Septic Tank Company.

Clyde Potts,
New York City. Consulting Engineer.

Correction in Formula Noted

Sir—Will you note that one of the formulas in my article "Column Sections Quickly Found by Novel Diagram," in *Engineering News*, Jan. 4, 1917, was published incomplete? The formula $l = \frac{N}{f}$ on p. 31 should be $l = \frac{N}{f}r$.

H. G. Nevitt.

Oklahoma City, Okla.

What Is Brake Load on a Bridge?

Sir—With reference to A. W. Buel's letter and following the writer's letter published in your issue of May 10, page 326, regarding your editorial query, "What Is Brake Load on a Bridge?" the following data, extracted from "Bridge Engineering," are submitted in connection with this query:

The braking thrust is generally greatly in excess of the starting force. For ordinary railway traffic, the maximum breaking force that may be expected will be about 20% of the weight on the drivers of the locomotive, about 10% of the weight of the fully loaded tender, about 17% of the weight of empty freight cars, and about 20% of the weight of empty passenger cars. Empty freight cars will rarely weigh over 1200 lb., and empty passenger cars over 2000 lb., per lineal foot. The total braking force exerted by a train will, therefore, be about 15% of the weight of the engine and loaded tender, plus a load per lineal foot of cars back of the tender amounting to about 200 lb. for freight trains and 400 lb. for passenger trains. As the uniform load assumed for a Class 50 loading is 5000 lb. per lin.ft., the proper braking coefficient for this load will be about 4% for freight cars and 8% for passenger cars. For Class 40 loading the percentages would be 5 and 10.

As the heavy, double-header engines specified for the standard loadings are rarely used except with freight

traffic, it is evident that the proper coefficient to be applied to the uniform load behind the locomotive is about 5%. For very short loaded lengths, therefore, the traction force should be assumed at 20% of the maximum live-load, and this percentage should decrease to 15% for spans about 120 ft. long, and to 10% for spans about 250 ft. long.

"Bridge Engineering" specifications provide the following formula for determining the percentage:

$$T = \frac{4000}{140L}, \text{ with } T_{max} = 20 \text{ and } T_{min} = 10$$

where T = percentage of total load to be used as tractive force, and L = loaded length in feet.

This formula will give, for lengths of 60 ft. or less, 20%; and for lengths of 260 ft. or more, 10%.

For electric-railway cars, the braking load should be assumed as 20% of the total load on the portion of the structure in question, irrespective of the loaded length, as in this case there is little difference between the weights of full and empty cars.

In truss bridges the only portions affected by the braking load are the floor system, the lateral system adjacent to the loaded floor, and the chords near-by, but the braking force should be transferred from the stringers through the lateral system to the trusses without bending the floor-beams transversely. Consequently, a proper method of detailing, to effect this purpose, should be used, such as referred to in the writer's previous letter on this subject. Regarding the suggestion in Mr. Buel's letter, published in *Engineering News* of Mar. 26, 1914, p. 689, that considerable economy might be effected in the design of trestle towers by the use of a comparatively small coefficient for the brake load, it would appear that the effect on traction loading of connecting adjacent trestle-towers by riveting the intermediate girders to both of them is to reduce the average thrust per lineal foot of structure on account of cars being lighter per lineal foot than locomotives and tenders. This continuity does not as might be supposed halve the thrust moment by putting a plane of contraflexure near the mid-height of tower, because the tops of towers are not truly fixed by such girder continuity.

In highway bridges no attention need be paid to brake loads, unless a street railway is carried, as an ordinary highway live-load does not produce any appreciable braking thrust.

F. H. Frankland,
Associate Engineer,
Waddell & Son, Consulting Engineers.
New York City.

A Military Engineer on the Civil Engineer

"I think that probably an engineer takes things more in a matter-of-fact way and sees them as they exist better, probably, than members of other professions. In his daily work he meets with problems in which he must place on the one side the things which he has to build, to construct, and on the other side he is opposed by the laws of nature; and he knows that in order to accomplish something he must face those problems, and if anything goes wrong the laws of nature, he knows, will come into play. For that reason he brushes aside the unessentials and usually arrives at a solution of the problem."—Major J. L. Schley before Louisiana Association of Civil Engineers.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Civic service rendered by engineering societies depends to a large extent on effective committee work. Committee work in turn depends on proper selection of personnel. Recently the Cleveland Engineering Society has been getting added results by appointing a personnel of mature minds and adding to each committee an energetic young man as secretary.

Cleveland Society Excels in Publicity

Perhaps the Cleveland Engineering Society is best known for its publicity methods. It gets real informing news of engineering into the newspapers, otherwise its matter would not "go." Evaluated by a money yardstick of advertising space occupied, the society's publicity has totaled $24,000 since it was started in 1912. Its latest and perhaps culminating effort in publicity is the publication of "The Conquerors," a 7 x 10-in. volume of 102 pages, conceived by A. J. Himes, past-president, and intended to be given away to laymen friends of the engineer to inculcate in them a better understanding of the fundamentals underlying the practice of engineering. But publicity cannot thrive on anything less than real works, a brief enumeration of which follows:

Working relations have been established with other civic organizations. Official representation has been maintained in the City Plan Commission. The Chamber of Commerce brought out a plan made jointly by the members of the society and the chamber, for straightening the Cuyahoga River. The society's publicity committee got a full-page spread in the newspapers. Although the war will doubtless stop the improvement, the scheme had the earmarks of a successful move.

Student Loan Fund

A student loan fund of $700, for helping worthy young men to gain a technical education, was started a year ago. The first recipient will be graduated this month.

The Building Code Commission enlisted the aid of the society and other organizations in stopping pernicious legislation introduced by plumbers, calculated to make more and costlier work in plumbing of no material advantage to the householder.

A committee on foreign engineering development has been following the changing situations closely and has staged a meeting at which the subject was the handling of freight in foreign ports.

After the industrial preparedness committee, headed by G. S. Merryweather, had assisted in doing the work its name implies, it proceeded to interest technical men who could be spared from the industries, in the army and navy. Its work has resulted in 15 commissions, and in addition the placing on file at the society's rooms of the records of 300 members who are ready to do the Government's bidding.

To supervise the expenditure of a $3,000,000 paving bond issue, it was suggested to the mayor that he appoint a committee, and such an appointment was made.

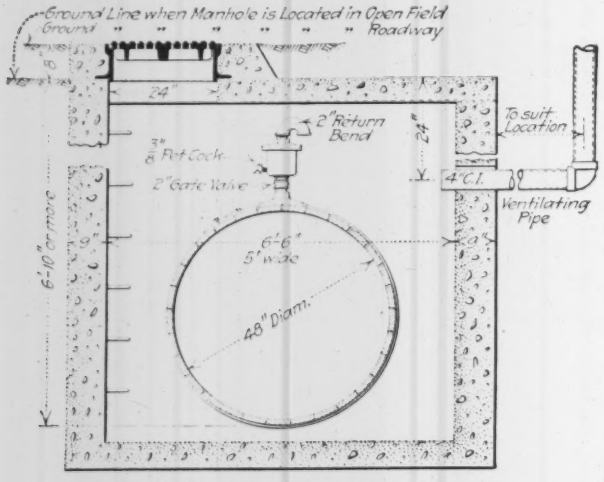
THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Put Air Valves on Wood-Stave Lines in Large Vented Vaults

AIR valves on the newer wood-stave pipe lines bringing water to Denver, Colo., from the mountain sources are placed in large concrete manholes. Formerly, it was the practice to use open manhole covers, but they have been discontinued in favor of ventilating pipes. The manholes could not always be depended upon, for earth and, in winter, snow and ice might fill the openings.

For a 2-in. Crispin automatic air valve, of which 100 are in use, set on the newer lines one at each summit, 4-in. ventilating pipes are used extended 8 to 10 ft. above



NO COLLAPSES WITH THIS DESIGN

the surface. If the supply pipe happens to be laid in a roadway, the ventilating pipe is led off to the side or even inside the fence line to protect it from injury. Small holes, aggregating in area many times the area of the air valve, are bored near the top of the pipe, which is plugged or capped.

The air valve is placed on top of the pipe with a return bend on the outlet, so that any water that may be delivered during the periodical test will not drown out the operator. To facilitate testing, the gate valve is set just above the special casting through which the connection to the wood pipe is made. Also, a hole is drilled in the lower part of the air-valve body for a pet-cock. On opening the pet-cock the float will fall, if held up by air or if it happens to be stuck. If water is holding the float up, the operation of closing the gate valve and opening the pet-cock will make the float work.

Where these air valves have been installed and an absolutely sure source of air, such as here provided, is assured, no collapses have occurred and the pipes are kept running full, the air being removed as fast as it collects, according to D. G. Thomas, chief engineer, Denver Union Water Co., who had the valves installed.

Kiln-Dried Douglas Fir Timbers Tested

BENDING tests were made upon four kiln-dried Douglas fir beams and minor specimens cut from them by the Forest Products Laboratory. Beams 1 and 2 were dried under high velocity, low-superheated steam, at a temperature of 225° F. for a day, 230° F. for the succeeding seven days, and 240° F. for the remaining four days. Beams 3 and 4 were kept at a temperature of 220° F. throughout the run, the steam being superheated for the first five days, when the humidity was reduced to 70%. During the next four days the humidity dropped gradually to 25%, where it was maintained during the remaining seven days. Beams 1 and 2 had a modulus of rupture of 6620 and 4910 lb. per sq.in. respectively, and beams 3 and 4 a modulus of rupture of 4740 and 6160 lb. per sq.in. respectively. All beams failed by horizontal shear due to the severe checking. The results are very encouraging for the development of the process for kiln drying Douglas fir beams in structural sizes.

Slope Measurements Taken at Eye Level Are Speedy and Accurate

By A. M. OCKERBLAD

Wichita Mapping and Engineering Co., Wichita, Kan.

ON EXTENSIVE surveys of the rough mountain land being acquired by the Federal Government under what is known as the Weeks law the chainmen could not keep up with the rest of the party, due to the roughness and steepness of the country. One set of chainmen could not average more than a half to three-quarters of a mile a day with an accuracy of 1 in 1000 to 1 in 1500, using the ordinary method of breaking chain. The writer finally solved the difficulty by what is perhaps a new method of taking slope measures, which allowed the same chainmen over the same terrain to make from one and a half to three miles a day with an accuracy of from 1 in 2000 to 1 in 3000.

Chain Held at Eye Level

The method is as follows: The rear chainman holds the rear end of the tape at the level of his eyes, using a plumb bob to center over the initial point. The front chainman holds the front end of the tape at the level of his eyes, using a plumb bob to transfer the chain length to the ground. After aligning and stretching as in ordinary chaining, the front chainman sets his point; and then each chainman, before moving his feet, determines the true per cent. or degree of slope between his own and the other man's eye, by means of a clinometer. The station distance as well as the slope between the points is recorded by the rear chainman or by both chainmen. Only full chain lengths or double chain lengths were used in the measurements, because it was found that

this method reduced the office work very materially. The chain was broken only to get odd chain lengths.

At the end of the day each chainman worked out the true horizontal distances by means of the accompanying table, which gives the two horizontal projections of the chain and double chain lengths from 1 to 102%.

TABLE MAKES SLOPE MEASUREMENTS TWICE AS ACCURATE AS BREAKING CHAINS—AND QUICKER

% Slope	Horizontal Projection 1 Chain	2 Chains	% Slope	Horizontal Projection 1 Chain	2 Chains	% Slope	Horizontal Projection 1 Chain	2 Chains
1	99,995	199,990	35	94,380	188,760	69	82,297	164,594
2	99,980	199,960	36	94,088	188,176	70	81,915	163,830
3	99,955	199,910	37	93,789	187,578	71	81,530	163,060
4	99,920	199,840	38	93,483	186,966	72	81,140	162,280
5	99,875	199,750	39	93,169	186,338	73	80,765	161,530
6	99,820	199,640	40	92,849	185,698	74	80,386	160,772
7	99,755	199,510	41	92,521	185,042	75	80,003	160,006
8	99,680	199,360	42	92,198	184,396	76	79,618	159,236
9	99,595	199,190	43	91,868	183,736	77	79,229	158,458
10	99,503	199,006	44	91,531	183,062	78	78,855	157,710
11	99,399	198,798	45	91,188	182,376	79	78,460	156,920
12	99,286	198,572	46	90,851	181,702	80	78,079	156,158
13	99,163	198,326	47	90,507	181,014	81	77,715	155,430
14	99,035	198,070	48	90,146	180,292	82	77,329	154,658
15	98,897	197,794	49	89,803	179,606	83	76,940	153,880
16	98,746	197,492	50	89,441	178,882	84	76,567	153,134
17	98,585	197,170	51	89,087	178,174	85	76,192	152,384
18	98,420	196,840	52	88,728	177,456	86	75,813	151,626
19	98,240	196,480	53	88,363	176,726	87	75,452	150,904
20	98,056	196,112	54	87,993	175,986	88	75,069	150,138
21	97,863	195,726	55	87,617	175,234	89	74,703	149,406
22	97,661	195,322	56	87,250	174,500	90	74,334	148,668
23	97,457	194,914	57	86,878	173,756	91	73,963	147,926
24	97,237	194,474	58	86,501	173,002	92	73,590	147,180
25	97,008	194,016	59	86,133	172,266	93	73,234	146,468
26	96,778	193,556	60	85,747	171,494	94	72,857	145,714
27	96,540	193,080	61	85,370	170,740	95	72,497	144,994
28	96,293	192,586	62	84,989	169,978	96	72,136	144,272
29	96,046	192,092	63	84,604	169,203	97	71,772	143,544
30	95,782	191,564	64	84,230	168,460	98	71,427	142,854
31	95,511	191,022	65	83,851	167,702	99	71,059	142,118
32	95,240	190,480	66	83,469	166,938	100	70,711	141,422
33	94,961	189,922	67	83,082	166,164	101	70,360	140,720
34	94,674	189,348	68	82,692	165,384	102	70,008	140,016

If degrees are used in obtaining the slope, the horizontal distance may be obtained by means of natural functions of the angles. The method of keeping notes is as follows:

```
0—2        25%
2—3        17%
3—4        — 6%
    4  52 Branch 0  05 ch. wide flowing S-10
4—6         8%
6—8        20%
    8  713 Corner.
```

The minus sign indicates that progress is downhill. In working up these notes, all that is necessary is to find the horizontal projection for two chains at 25%, one at 17% and one at 6% and add them all together. This gives the horizontal distance from the initial point to Sta. 4. Now add 0.52 and get the horizontal distance to the branch. Look up horizontal projection of two chains at 8% and two chains at 20% and add them to the horizontal distance of Sta. 4 and get the horizontal distance to Sta. 8. Now add 0.713 to this and get the length of the line.

Cliffs Are Easily Passed

This method facilitates measurements very much, as it enables one to take long sloping shots. A proper manipulation of stations will allow the easy passing of cliffs that would seriously delay chainmen using the method of breaking chain. It was found in the work in the southern mountains that lost corners could be located with greater precision after we adopted this method of chaining, because the field notes and measurements give a close approximation of what is known in that section as "ground measure." The reason for this is that all lines of the old grants were measured along the ground—that is, the original chainmen made no attempt to hold the chain levels.

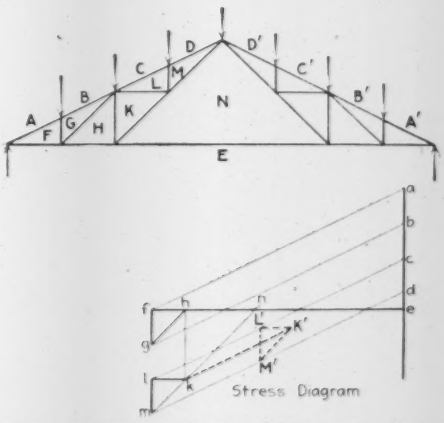
The method has been proved accurate by continuous use for over two years and a half, and the same results can be obtained by ordinarily careful chainmen over ground varying from 0 to 100%. A greater accuracy is obtained on slight slopes, say from 10 to 30%, than is required in higher slopes, but it is probable that in any case this method will give better results than breaking chain.

Graphic Solution for Fink Roof Truss

By W. V. KULP

A SIMPLE general solution for the graphical analysis of the Fink type of roof truss can be made without resorting to the usual expedient of substituting auxiliary members or using partly analytical methods. For example, consider the modified Fink truss shown in the diagram. The only load affecting the truss members LM and LK is CD, and hence these stresses can be readily found graphically.

Select any convenient point M' on the line drawn through d in the force diagram parallel to the rafter of the truss. Draw $M'L'$ parallel to ML, giving L' on the line through c. Draw $L'K''$ parallel to LK, and $M'K''$ parallel to MN, as shown. The triangle $L'M'K''$ thus formed gives the true stresses in ML and LK, and also



MODIFIED FINK TRUSS ANALYZED GRAPHICALLY

the true relative position of the point K'' with respect to the parallel lines through c and d.

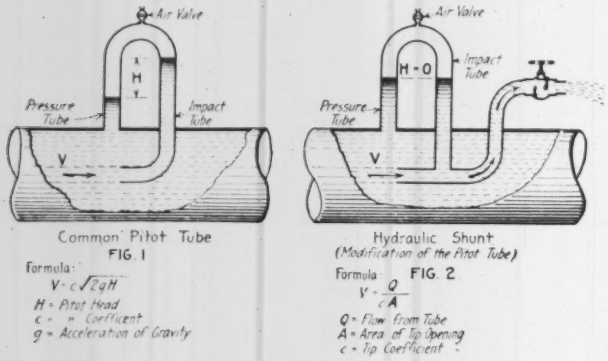
The true position of K', however, must be on a line through h parallel to HK, and therefore lies at k in the stress diagram found by $K'k$ drawn parallel to the rafter. With k located, the remaining stresses are found as usual. The method can be applied to any loading and to unsymmetrical Fink trusses.

Chestnut Oak Makes Good Treated Ties

Until recently practically all railroads in the United States accepted chestnut oak on the same basis as white oak, but tests at the Forest Products Laboratory and at one commercial wood preserving plant show that chestnut oak in addition is much like red oak as regards ease and desirability of treatment. Because of the durability of white oak, it is one of the most desirable tie woods in its natural state, but it is difficult to treat. Red oak is less durable untreated, but does take treatment readily.

Modified Pitot Gives High Accuracy

THE pitot tube has long been used as a device for measuring the flow of liquids and gases, but only when used with the utmost care have the results proved uniform. Many experimenters have worked with modified forms in the endeavor to reduce the variation in



ALMOST AS SIMPLE AS A PITOT TUBE

results, but it is evident not only that the data obtained are variable in the hands of different men, but that the same tube may have different coefficients.

In order to correct this latter defect, Prof. H. A. Thomas has devised what may be termed the "Hydraulic Shunt-Flow Tube," which is described in the March issue of the *Revue Technic*, p. 176. This device is a tube so arranged that it may be introduced into the stream with the tip directed against the flow and yet maintain at the tip the same pressure that existed before the introduction of the tube. The water flows into this tube and may be shunted into a small container and weighed, leaving the velocity undisturbed from the normal.

The velocity of flow at the tip of the tube will be equal to the quantity of water collected in the measuring tank, in a measured time, divided by the area of the tip—all quantities being measured in the usual units. It is possible to demonstrate mathematically that turbulent flow should not affect the coefficient of the tip. Theoretically, of course, the tip coefficient should be unity under all conditions, but a series of experiments undertaken with this in view show that it varies less than 1%—the pitot coefficient under like condition varying more than 4%.

Safety and Comfort on Oil-Maintained Roads at $25 per Mile

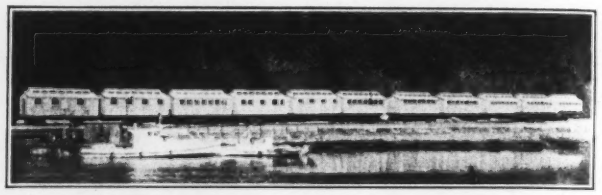
THE slippery, dirty condition of a recently oiled road is one of the most disagreeable and dangerous features of highway maintenance. According to Fred W. Sarr, second deputy highway commissioner of New York, the experience last year in that state proves conclusively that the time a road remains objectionable from a traffic standpoint can be reduced from one-half to three-fourths at an additional cost of only about $25 per mile, as a result of a slight change in the character of the road oil. Experience during several years shows that the best road oil for light surface treatment in New York State contains about 65% of asphalt and must be heated to a temperature of about 100° in order to be sprayed successfully on the road, except during very hot weather. The improvement in treatment lies in an alteration of the material used to flux the asphaltum or pitch base. This flux is now required to have about 50% of light volatile oils that will evaporate in two days after the surface application is made, leaving the roadway free from the objectionable condition.

Zinc Borate Retains Fire-Resisting Power

The Forest Products Laboratory has just fire-tested a small shingle roof section, painted with a zinc borate paint, which has been exposed to the weather for nearly three years—other shingles specially treated with the same paint being used as a control. The results show that the paint had resisted the action of the weather without losing its fire-retarding properties to any marked extent.

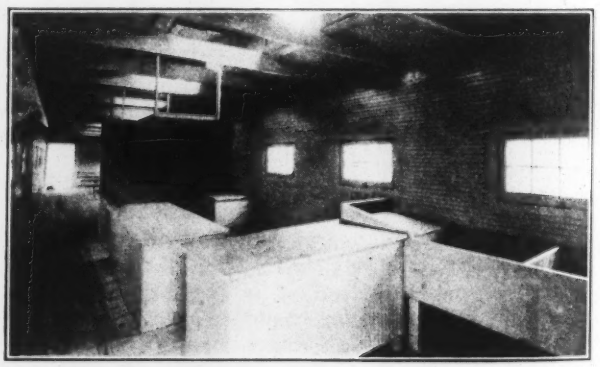
Mobile Logging Camp Built on Flat-Cars

THE Northern Lumber Co., of Leavenworth, Wash., has recently had built for it several trains of camp-cars which may be transported over any standard line with safety and which are equipped with air brakes and all necessary safety appliances. These cars are built on discarded trucks equipped with new 60-ft. 5 x 10 sills,



SAVES ITS COST IN FIRST FEW MOVINGS

eight sills to the car, decked with 2-in. ship-lap covered with 1 x 4 tongue-and-groove flooring, on which is built the superstructure of standard-car siding and ceiling. A train is made up of the following units: Eight bunk-cars, two full diners and four kitchen-diners. The latter are equipped with kitchens at one end and the dining section at the other, it being desired to use these



KITCHEN IS SIMPLE AND COMPLETE

cars for the accommodation of small crews of from 20 to 30 men. This method of housing logging crews is much cheaper than the old method of using the skid-camp. Cost data show that, while the car-camp costs more initially, the addition is made up by the cost of moving the skid-camp only once.

NEWS OF THE WEEK

Current Events in the Civil Engineering and Contracting Fields

Predict Danger for Colorado River Levees

A report from the board of consulting engineers employed by the Imperial irrigation district recommends that levees, particularly in the Saiz and Volcano Lake districts, be raised 2 ft. and riprapped on the water side, and that a railroad be constructed to Black Butte at once so that rock may be available. A patrol along the levee is also recommended.

"The best information obtainable," the report states, "indicates that the State of Colorado, which contributes 50% of the flow of the river, has had this year a rainfall 16% greater than that of 1914, when the previous break in the Volcano Lake levee occurred."

Up to the present time temperatures on the higher altitudes of the watershed remain at freezing point part of the time, which tends to a slower melting and probably longer medium high-water conditions.

Water-Supply of Oklahoma Town Cut Off by Dynamiters

A standpipe at Dewar, Okla., holding 110,000 gal. of water, was dynamited and rendered useless at 11 p.m., June 1. The standpipe was located on Dewar Mountain, a half-mile northeast of the city. The water rushed down a canyon and passed off into a creek without further damage.

Los Angeles Aqueduct Power Bonds Defeated

A proposed $2,000,000 bond issue to continue hydro-electric development along the line of the Los Angeles aqueduct was defeated by a heavy majority at a popular election June 5. Of the sum named, $1,000,000 would have been used for a 25,000-hp. installation at San Francisquito Canyon site No. 2, to utilize water now wasted in a temporary flume after passing through San Francisquito plant No. 1, which went into operation May 10. The sum of $250,000 would have built a 5000-hp. plant in Franklin Canyon, and $750,000 would have been devoted to the first section of proposed power tunnels.

Illinois Legislators Vote for $60,000,000 Road Bonds

The state legislators of Illinois last week passed a bill providing for the construction of 4400 miles of hard road to cost $60,000,000. The law must go to a state-wide referendum in November, 1918. Serial 20-year bonds bearing not to exceed 4% are to be issued. The law is so worded that most of the money will come from the motor taxes. Forty-six different routes are laid out.

Engineers Give Opinions on Public Work

Higher Prices Cannot Interfere Immediately, Though Public Is Apprehensive—Municipal Work Undertaken Only Where Necessary

Letters sent to public officials and consulting engineers having public work in charge are bringing back answers which indicate that, while the present condition is bound to exert an influence upon the volume of construction that will be undertaken by municipalities, for a while at least the normal amount of work will continue. There seems a tendency to limit new undertakings to those actually demanded by immediate necessity, but this is more or less the character of all municipal improvements. While in some cases legal considerations have made unavoidable the rejection of all bids on account of the figure being too much in excess of the estimate, in many other cases provision has been made to guard against this contingency and if possible forestall such complications by higher estimates.

Routine Work Proceeding

The City of Milwaukee has made no material restrictions or limitations in the program of public-work construction for the current season. According to Fred G. Simmons, commissioner of public works, much of the work that might be designated as largely routine is now under way, and contracts are being let weekly to the extent that the construction work for the season will be at least up to the normal. The prevailing thought in official circles seems to be to the effect that no materially lower prices can be expected for several years to come, at least so far as construction operations are concerned. It is therefore felt that the city cannot afford to stand still or go backward in the matter of improvement; and while there is no desire to spend money for unnecessary things, there is a general willingness to proceed with the ordinary city requirements.

Mr. Simmons is of the opinion that the present critical situation, so far as the war creates abnormal conditions, undoubtedly deserves and should receive first consideration, but the Department of Public Works does not think that the great majority of the citizenship, which will remain home in any case, would be benefited to any degree by a rigid and inadvisable restriction of expenditures at this time.

Work Will Be Undertaken in Spite of the War

The fact that a large number of public improvements are not undertaken until absolutely required makes N. T. Veatch, Jr., of Black & Veatch, consulting engineers, Kansas City, Mo., think that there will continue to be considerable work done. It is his opinion that the present season will show little if any slowing up, since the large amount of work contracted for in that vicinity gives indications of making the present season as busy if not busier than last year, though it is somewhat of a problem to forecast just what the conditions will be.

While there will be of course a desire to avoid any work which can be put off until later, Mr. Veatch feels that unless conditions change considerably there will be a considerable amount of public improvements undertaken in spite of the war conditions and the high cost of material.

Funds Provided Last Year

Construction on public work in Cleveland is being done to carry out plans which were for the most part completed last year, and is being paid for from funds which were either established at that time or were provided for early this year. Robert Hoffmann, commissioner of engineering and construction, Department of Public Service, believes that public-work construction will continue during the current year to at least the normal amount which has been customary in recent times. The fact that prices are considerably higher than usual will curtail the total amount of work which will be done in certain places, where appropriations for such

First Reserve Engineer Regiment Has Reached Full Complement

Capt. John P. Hogan, First Reserve Engineer Regiment, in charge of the recruiting station at 190 Sixth Ave., has announced under date of June 7 that the full complement of 1061 enlisted men for the regiment was reached Saturday, June 2. The men are being ordered into active service at the temporary quarters at Fort Totten, near Whitestone, Long Island, as quickly as their equipment can be handled. In addition it has been decided to establish a depot battalion of about 200 men to act as a reserve, and this supplementary enlistment should be reached in a few days.

Through Robert Ridgway, who acted as chairman of the subcommittee on recruiting for the regiment, the following men who assisted him were thanked for their assistance: J. W. Lieb, R. S. Buck, Walter J. Drummond, F. J. MacIsaac, F. L. Crawford, W. S. Menden and R. K. Tomlin.

work are limited and were based upon estimates made a year or more ago. In a number of cases the work is of such character that it could not be completed in one season, and the appropriation was originally made large enough to cover more than a season's work.

Property Owners Protest

Where improvements are partly paid for through assessment upon abutting lands, such as pavements and sewers, the Department of Public Service is experiencing considerable protest from property owners against the improvement, by reason of the taxes which they will have to pay. The argument upon the part of the property owner is that the costs at this time are excessive, and by reason of the high cost of living and probable increase in general taxes the making of such improvements at this time is inadvisable. It is recognized, however, that certain of these improvements are so necessary that they cannot be wholly postponed by reason of these protests. Mr. Hoffmann says that the advantages to be gained by providing proper pavements and adequate sewers in certain locations are sufficient to warrant the extra expenditure involved by the construction of either at this time. The matter, however, demands the exercise of good judgment in the selection of improvements of this kind.

Work Up to Normal

The amount of labor which can be obtained for construction work in Cleveland is limited and may result in decreasing the total amount of work that can be accomplished, though it is difficult at this time to form any estimate upon how far reaching this particular condition may be. Indications are that public work to be completed this current season will be up to the normal. It is also to be noted that there is considerable work in contemplation for next season.

The large program of public-works construction already ordered and financed will be carried out during the current season in St. Paul and Minneapolis, excepting as it may be affected by delay in material deliveries, according to George H. Herrold, assistant city engineer of St. Paul. There have been some requests on the part of contractors for an extension of time, some indicating an apprehensive feeling as to the labor and material situation. On public work ordered, but not contracted, St. Paul is now able to get bids only on the best work, indicating that contractors are taking no chances. On May 28 bids were taken on the Jefferson-Cretin sewer system, estimated to cost $45,000. The lowest bid was 11% above the estimate, material for the job advancing $22,000 between the making of the estimate and the taking of bids. The chief engineer, O. Claussen, after interviewing the petitioners for the improvement, has advised the rejection of the bids and the postponement of the work. This system, however, was largely for the development of new territory.

Technical Experts To Help Build Cantonments

Services To Be Supplementary and Not Substitutional—Four Contracts Let

Preliminary work toward the construction of the cantonments for the new army is proceeding rapidly. The problem is one of the largest which the Engineer Corps has ever had to meet, involving as it does the construction of 32 cities of between 20,000 and 30,000 inhabitants each within a period of a little more than two months. These cities will be of sufficient permanence not only to require substantial buildings, but well-constructed roads, sanitation, sewerage and water systems, heating and lighting systems, and perhaps as difficult as any part of it, adequate railroad connections.

The proportions of the work might well prove staggering were it not for a group of volunteer technical experts. Among them are some of the most prominent engineers, contractors and city planners in America, who have offered their personal services and the aid of their organizations for the efficient accomplishment of the work. All are serving without compensation in the common effort to make the new army cities models of their kind.

Prominent Engineers Volunteer

Among names made public June 11 of those who have volunteered their services and who have been called into consultation were Leonard Metcalf, of Boston, a consulting engineer on water-supply; George W. Fuller, of New York, a consulting engineer on water-supply and sewers; E. P. Goodrich, of New York, engineer on city planning; Nicholas Hill, New York, engineer on water-supply; R. W. Hunt, New York, consulting engineer; Otis W. Post, New York, architect; John Ihldor, New York, city planner; George B. Ford, New York, city planner; Charles Butler, New York, hospital architect; E. F. Stevens, Boston, hospital architect; G. A. Reeder, New York, architect, and A. E. Phillips, superintendent of sewers of the District of Columbia. All of these men dropped their own work to start for Washington when the call came, and offered their services with the idea of being "supplementary, not substitutional." In coöperating with the Engineer Corps and the Quartermaster's Department of the Army they are seeking to avoid any possible duplication of work.

Will Prepare Organization Chart

H. B. Eaton, an engineer with a broad experience in estimating and planning, was borrowed from the du Pont company to prepare an organization chart and to advise on quantities and costs of materials for the cantonments. Howard L. Rogers, of the Stone & Webster Corporation, assisted in forming the organization to handle the cantonment construction.

The Quartermaster's Division of the War Department has awarded contracts for the construction of four of the new army cantonments. While the terms of the contracts were not known at the time of going to press, the awards were as follows: Ayer, Mass., to F. T. Ley & Co., of Springfield; Wrightstown, N. J., to Erwin & Leighton, Philadelphia; Columbia, S. C., to Hardaway Contracting Co., Columbus, Ga.; and Atlanta, Ga., to Arthur Tufts, of the latter city.

Pennsylvania Cuts Road Appropriation

The Appropriations Committees of the Senate and the House of Representatives of Pennsylvania have agreed upon the appropriations for the State Highway Department for the next two years, wtih the result that a substantial reduction in the original budget is contemplated. As introduced in the House of Representatives, the bill made an appropriation of $12,000,000 for state-highway construction in townships and $2,000,000 for state-highway construction in boroughs. These items have been reduced to $7,000,000 for the construction of state highways in boroughs and townships. The state-aid appropriation of $3,000,000, as originally planned, has been reduced to $2,000,000. The item of $500,000 for the purchase or condemnation of turnpikes remains unchanged, and the township bonus for earth roads, which is disbursed through the State Highway Department, is substantially the same as in the original bill. This sum will build only 350 miles of improved roads during the next two years, leaving the state with over 6350 miles of earth roads on state-highway routes.

Kings River Project in California Sanctioned by Legislature

Governor Stephens, of California, has signed the Hawson bill amending the California irrigation act in such a way that the construction of the dam at Pine Flat, on Kings River, will now be possible. This project, report of which appeared in the "Engineering Record" for Aug. 12, 1916, is to supply water for irrigating about 1,200,000 acres in Fresno, Tulare and Kings Counties.

Yonkers To Develop Port

Yonkers, N. Y., which lies along the Hudson River just north of New York City is preparing to develop its port equipment along modern lines, and has retained H. McL. Harding, Consulting Engineer, of New York City, to submit plans and designs for the work. The present port equipment consists of old piers and quay walls adjacent to but in very poor connection with the marginal tracks of the New York Central R.R. The new scheme will probably comprise quay walls and warehouses back of the railway with gantry cranes connecting the three.

Concrete Grain Elevator Withstands Tornado

Two timber-frame grain elevators were blown to pieces by the tornado which hit Andale, Kan., on May 25, but one of reinforced concrete immediately adjacent passed through the storm without damage. The view shows the wreckage of one old timber structure at the right, in line with the locomotive, and another in the middle of the picture. The concrete elevator is in the rear, intact except for broken windows.

To Make Investigation of Kansas Surface Waters

The Kansas Water Commission has arranged coöperation with the United States Geological Survey for a detailed investigation of the surface waters of Kansas. In carrying out this work the Survey established on June 1 a district office in the Federal Building, Topeka, Kan., under the direction of Roger C. Rice, district engineer. The Kansas Water Commission comprises the following: Governor Capper, ex officio chairman; T. J. Strickler, Topeka, chief engineer of the Public Utilities Commission, secretary; H. A. Rice, professor of civil engineering, Kansas State University, Lawrence, and H. B. Walker, drainage engineer, Kansas State Agricultural College, Manhattan, who is engineer for the commission.

It is the plan of the commission to establish stream-gaging stations on the more important streams and tributaries of the state. These records will be of especial value in assisting with the solution of the serious flood problems of eastern Kansas. One of the first gaging stations to be installed will be on the Kansas River at Topeka.

Defense Council Appoints Cement Committee

B. M. Baruch, chairman of the Committee on Raw Materials, Minerals and Metals of the Advisory Committee of the Council of National Defense, has appointed the following committee to represent the portland-cement industry: John R. Morron (chairman), Atlas Portland Cement Co.; B. F. Affleck, Universal Portland Cement Co.; George T. Cameron, Santa Cruz and Standard Portland Cement companies; Richard Hardy, Dixie Portland Cement Co.; E. M. Young, Lehigh Portland Cement Co.

J. P. Beck, general manager, Portland Cement Association, will serve as secretary of the committee. **The committee had its first meeting in New York a few days ago to discuss methods of cooperation with the Government in supplying its needs for portland cement during the war.**

Wentworth Institute Places Plant at Disposal of War Department

Wentworth Institute, Boston, has placed its entire plant at the disposal of the War Department, so that technical training in military engineering may be facilitated for enlisted men. The faculty of the institute is working in coöperation with the officers of the First Regiment of Engineers, Fifth Division, United States National Guard. A course of instruction is being given that will continue probably into the fall months.

Sewage Treatment for Los Angeles Again Defeated

For the second time within a year or so the voters of Los Angeles, Calif., have voted down bonds for sewage-treatment works, notwithstanding the fact that the city is under orders from the State Board of Health to install such works. At an election on June 5 a large majority of votes were cast against a bond issue of $1,750,000 for a large plant at Hyperion to treat 97% of the sewage of the city and a small plant to treat the sewage from the San Pedro district. The city is already building a new sewer to take the place of the last two tunnels on the old outfall sewer and is also building a new ocean outfall section and pier, both by force account from the general fund. The new ocean section of the outfall will be 2000 ft. long. Sewage will be discharged at five points along the last 100 ft. of the ocean section, in 18 ft. of water. The disposal works proposed at Hyperion consist of Imhoff tanks, sludge beds, ocean outfall section, etc.

Erect Monument to Man Who Made Survey for Chicago

A monument to the memory of James S. Thompson, who made the original survey of and laid out the site of Chicago, has been erected over his grave at Evansville, Ill. The monument was erected from funds contributed by Mayor W. H. Thompson, of Chicago, who, however, is in no way connected with the man to whom the monument was dedicated.

Propose Fifty-Mile Military Road North of Chicago

A military road between Chicago and Waukegan has become almost a necessity because of the heavy motor-truck and fast-moving traffic that is sure to develop due to the army forces at Fort Sheridan and those of the navy at the Great Lakes naval training station near Waukegan. Capt. W. A. Moffett, commandant of the latter station, started the agitation last week at a conference of representatives from north-shore cities, Cook and Lake Counties, the state, the railroads and the Sheridan Road Improvement Association. Charles E. Russell, city engineer, Highland Park, with B. H. Piepmeier, Illinois State Highway Department, and Frank Windes, consulting engineer, will report June 8 on a general plan of route, width and cost. It is the opinion of some of the engineers that Sheridan Road and Ridge Ave., repaired in a few places, will furnish a temporary expedient, but temporary only, for it will not long stand up under heavy-truck traffic. So another route of heavy base and extra width will be necessary.

While the question of financing the road has been discussed but briefly, the best general opinion seems to point to the division of the cost as follows: 50% from the Government, 25% from the state-aid fund of the Highway Department and 25% by a general assessment.

Texas Governor Appoints Highway Commission

On June 4, Governor Ferguson, of Texas, appointed the following members of the State Highway Commission: Curtis Hancock, chairman, Dallas, Tex.; T. R. McLean, Mount Pleasant, Tex.; H. C. Odle, Meridian, Tex. George A. Duren was appointed state highway engineer. As the automobile license tax becomes effective July 1, 1917, the commission will immediately organize and perfect a registration system. It is estimated that about 175,000 automobiles will be affected by this tax and that nearly $1,500,000 per year will be obtained in this way.

Goethals Drops Eustis and Clark from Corporation

Disagreement Over Wooden-Ships Program Is Given as Cause for Dismissal

The controversy in the Emergency Fleet Corporation over the rejection of the original extensive wooden-ship program by General Goethals reached a crisis last week, when his two subordinates, F. A. Eustis, assistant general manager, and F. H. Clark, engineer, were asked to resign. Messrs. Eustis and Clark are champions of the wooden-ship program and believe that its rejection means the neglecting of vast tons of shipping that could really be built without interference with Goethals' favored steel-ship program.

Successors Appointed

General Goethals has appointed Admiral H. H. Rousseau as assistant general manager of the Emergency Fleet Corporation to succeed F. A. Eustis, and Samuel L. Fuller has been appointed to fill the position of F. H. Clark.

The original wooden-ship program called for a mammoth wooden fleet, and it appeared at first to be very plausible. However, after careful consideration, General Goethals favored a steel-ship program and will cut down the wooden ships to about one-tenth the number originally determined upon, claiming that the scheme is absolutely impracticable and hopeless. He has also restricted the type of wooden boat, modified the original design and called for a lump-sum price instead of the cost-plus-percentage bid. His former aids claim that the new method of bids is causing unnecessary delay, inasmuch as contractors are not willing to take chances with conditions as they exist today. Goethals maintains, however, that in wooden-ship construction the corporation is paying for the ways and necessary equipment when requested and is protecting the contractor on account of advance in cost of labor and in price of materials—saying, further, that the only contingency unprotected is inexperience, which is not a contingency, if the prospective contractor possesses the necessary organization for carrying on the work. Representative lumbermen from the Pacific Coast apparently support Goethals in his contention, claiming it would be practically impossible to obtain a sufficient quantity of the kind of lumber needed to carry out the wooden-ship program.

Program Is Proceeding

In spite of this difference, 16 wooden ships are provided for in the new contracts announced June 12 by General Goethals. This brings the total of wooden ships contracted for up to 30. The summary follows: Total number of contracts executed, 12; total number of ships and hulls contracted for, 104; complete steel ships, 18; complete composite ships, 32; complete wooden ships, 30; total complete ships, 80; wooden hulls, 24.

Military Section of the Engineer Corps Crowds War Department

All the divisions of the office of the chief of engineers, including the river and harbor division, under Colonel Newcomer; the miscellaneous division, under Colonel Keller, and the contract division, under Major Kelly, have been transferred from the War Department to new quarters in the old Land Office building, at the corner of Seventh and E Sts., Washington, D. C. The change was made for the purpose of making room at the War Department for the new and enlarged military section of the Corps of Engineers, under Colonel Winslow.

Virginian Railway Will Enlarge Norfolk Coal Terminal

Work has been started by the Virginian Ry. on additions to the coal terminal at Sewalls Point, near Norfolk. A car dumper, an elevator, six conveyor cars and either one or two track scales will be added, besides more yard tracks and additional electrical equipment for operating the enlarged plant.

State-Highway Officials Meet

At an informal meeting of state highway officials and others interested in roadbuilding, it was decided to empower a committee to wait upon the railroad subcommittee of the Council of National Defense to urge that road materials and machinery be taken off the embargo list. It was the generally expressed opinion that, as much of our success in the war will depend upon the roads and their condition, any impediment to the maintenance of existing roads, the completion of work under way or the undertaking of badly needed extensions should be removed. R. A. Meeker, state engineer of New Jersey, presided, and among those in attendance were Governor Carl E. Milliken, of Maine; John F. Richmond, chairman of the Rhode Island Highway Commission, and J. W. Barber, assistant state engineer of Maine.

American City Planning Institute Formed

The American City Planning Institute was formed at the ninth annual City Planning Conference held at Kansas City, Mo., May 7 to 9. By this action the loosely organized conference, controlled by a committee, becomes a permanent organization. For the coming year, Frederick Law Olmsted, who has been chairman of the conference from its inception, will be president of the institute, but the new constitution provides for changes in the presidency. Flavell Shurtleff, 19 Congress St., Boston, Mass., continues as secretary. Engineers on the Board of Governors of the new institute are Nelson P. Lewis and E. P. Goodrich, New York, and George S. Webster and B. A. Haldeman, Philadelphia.

Cleveland Coal Operators' Terms Not Satisfactory

Lighting Commissioner Upholds Heat-Unit Clause Contained in Specification

Mayor Davis, of Cleveland, announced June 7 that the city will not accept the coal terms proposed by the coal operators, who, at a recent meeting, declared they are willing to sell the city the coal required by all departments for a year, for $3.50 a ton at the mines. This price would be about $4.40 for coal delivered in the city.

The operators stated at the meeting with city officials recently that under the new arrangement the city would be obliged to take coal as it came and that the heat-unit requirements contained in city specifications could not be regarded.

W. E. Davis, lighting commissioner, opposed this plan, urging that immediate attention be given the coal situation, as prices now being paid by his department will make it difficult to maintain present lighting rates.

City Law Director FitzGerald is of the opinion that Cleveland has the legal right to purchase a coal mine. The City Council recently adopted a resolution asking for a legal opinion on this question. The council is in favor of this action. Mr. Davis has recommended the selection of an expert to assist the city in selecting the coal property.

Reserve of Public Health Service Proposed

Joint Senate resolution No. 63, introduced May 15, authorizes the organization of a reserve of the United States Public Health Service in times of national emergency and, if passed, would appropriate $300,000 for this purpose. The reserve would be organized under the direction of the Secretary of the Treasury, and under such rules and regulations as the President might prescribe. It would be composed of officers commissioned by the President for five years, subject to revocation of commissions in the discretion of the President. The commissions would be issued after examinations to determine physical, mental and moral fitness of candidates. Such a commission would not exempt the holder from military or naval service. The health reserve officers would be entitled sanitarians, senior assistant sanitarians and assistant sanitarians. When ordered to active duty in the service of the United States, they would receive the pay, allowances and leaves of absence of surgeons, passed assistant surgeons and assistant surgeons respectively. The number of reserve officers is left to the discretion of the Secretary of the Treasury and the limitation of funds available for their payment. Up to June 2 the bill had not been reported from the Senate Committee on Public Health and National Quarantine.

Personal Notes

C. **Douglass Buck**, of Wilmington, Del., has been appointed chief engineer of the du Pont Highway, Sussex County, Delaware, to succeed Charles M. Upham, who has resigned to become state highway engineer.

Charles A. Mead, engineer of bridges and grade crossings for the Board of Public Utility Commissioners, New Jersey, will be in charge of the highway bridge work of the State Highway Commission, under statute provisions allowing such coöperation between state departments.

Milton J. Whitson, of Seattle, representative of Grant, Smith & Co., one of the largest contracting firms in the Northwest, has been offered and accepted the position of construction manager in the United States Quartermaster's Department for the building of camps for 1,000,000 men. In his new position,

Has Accepted Position of Construction Manager of the U. S. Quartermaster's Department

MILTON J. WHITSON

Mr. Whitson will supervise the expenditure of $100,000,000 during the next three months. Mr. Whitson has an enviable reputation as a builder in the Northwest, having superintended the construction of the block of buildings for the Metropolitan Building Co., including the White, Henry, Cobb and Stuart buildings. The St. Paul terminals, recently completed, are another example of Mr. Whitson's supervision. When the fact that Mr. Whitson is not yet 40 years of age is taken into consideration, his record as a builder and his present appointment mark him as one of the coming men in his line on the coast. Mr. Whitson was born in Davenport, Iowa, and is a graduate of the University of Illinois.

Charles S. Sincerbeaux, of Princeton, N. J., has been appointed by the Board of Freeholders of Mercer County to examine various county bridges.

Frank Petefish, Hudson Harlan and **Anton Wandt** have recently been confirmed by the State Highway Commission of Kansas as county engineers of Scott, Trego and Lincoln Counties respectively.

Ira P. Williams, member of the State Board of Mines and Geology, Salem, Ore., has been selected by the Desert Land Board to succeed H. A. Parks as a member of the commission to investigate the leak in the Tumalo project.

W. Owen, former city engineer of Nanaimo, B. C., has been appointed construction engineer of the Canadian collieries at Cumberland, British Columbia.

Glenn S. Reeves, formerly structural draftsman with the Bethlehem Steel Bridge Corporation at Steelton, Penn., has been engaged as assistant civil engineer for Central Romana, at La Romana, R. D.

H. E. Fowler, recently chief plan examiner, city building department, Seattle, Wash., has been appointed assistant superintendent of buildings, to succeed D. E. Hooker.

Howard Arrison has resigned his position as assistant district engineer in the Philadelphia Highway Bureau, to become associated with the firm of Albright & Mebus, consulting and construction engineers.

Frederick C. Dunlap succeeds William H. Connell as chief of the Philadelphia Highway Bureau. Mr. Dunlap has been assistant engineer in the Transit Department for about a year and was for five years chief of the Water Bureau.

E. G. Harris, of the Missouri School of Mines, has been appointed highway engineer by the commissioners of the Special Road District of Rolla, Missouri.

W. J. Carter, representing the Cleveland Engineering Society, has been made a member of the Cleveland Grade Crossing Commission, which will have charge of the appraisal of property and other matters pertaining to the elimination of grade crossings.

Harry W. Hand has been elected president of the William Cramp & Sons Ship and Engine Building Co., Philadelphia, Penn., to succeed Henry S. Grove, resigned.

Bernard Blum was recently appointed division engineer of the Northern Pacific R.R. He graduated from the Massachusetts Institute of Technology in 1904 and entered railroad service in the following year.

John B. Wright has been appointed city engineer of Attleboro, Massachusetts.

Clinton H. Kearney has resigned as commissioner of streets and public improvements of San Antonio, Tex., to take up work in Spain.

E. R. Morgan has resigned the office of state road engineer of Utah.

Ernest P. Goodrich has recently been appointed chairman of a subcommittee under the Council of National Defense to cover certain phases of cantonment location, design and construction. He has lately been appointed director of the Bureau of Municipal Research of New York City and, as mentioned in these columns May 24, has also been made director for New York City of the Military Census of New York State. In this latter work he is in charge of the organization of an administrative ma-

Appointed Chairman of Committee on Cantonment Location

ERNEST P. GOODRICH

chine, consisting entirely of volunteers, which will aggregate nearly twenty thousand people. This organization will handle the census of approximately three million individuals. Mr. Goodrich is also active in connection with other military affairs, as consultant for contractors constructing large housing developments near munition plants. He graduated from the University of Michigan in 1898 and immediately entered the United States Navy as civil engineer. Later he became chief engineer of the Bush Terminal Co. and at present enjoys an extensive consulting practice. Mr. Goodrich has served as consultant for the Borough of Manhattan and has been affiliated with many engineering projects, such as harbor improvements in the Philippine Islands, investigation of possibilities of developments of slack-water navigation on several small tributaries to Ohio River, including dams, locks, railroad and coal-handling facilities; New York Barge Canal terminals and many city-planning surveys. He translated "Der Eisenbetonbau," by Prof. Emil Mörsch.

M. I. Evinger resigned his position, as a member of the civil engineering faculty of Iowa State College, on Feb. 1 to become chief engineer of the Refinite Company, Des Moines, Iowa. This company is developing and marketing apparatus for softening water.

Louis C. Fritch, formerly general manager of the eastern lines of the Canadian Northern Ry., has been appointed to the same position with the Seaboard Air Line, succeeding C. L. Lake, resigned. Born in Springfield, Ill., 1868, Mr. Fritch graduated in civil engineering from the University of Cincinnati, much later taking a post graduate course in law. He took up engineering on the Ohio & Mississippi Ry. as supervisor's assistant. In 1886 he was transferred to Cincinnati and the following year was made assistant engineer. Holding this position until 1892, in that year he was made engineer, maintenance-of-way and chief engineer of the Cincinnati & Bedford Ry., which was under construction. The following year he was appointed division engineer of the Baltimore & Ohio Southwestern R.R. and at once began the study of revising the grades between Cincinnati and St. Louis, carrying out one of the first extensive grade reductions in the Middle West. In 1904 Mr. Fritch became connected with the Illinois Central to make a special study of large terminals, with the title of assistant to the general manager. In 1906 he was made assistant to the president, and in 1909, as consulting engineer for the company, he made a study of the electrification of the Chicago terminals. Later in the same year he was called to the Chicago Great Western as chief engineer, and in this capacity directed the rehabilitation of this road following its receivership. Mr. Fritch was one of the founders of the American Railway Engineering Association and is now the senior member. The Association's first secretary, he was president in 1909.

Albert L. Upham, formerly with the Association of Portland Cement Manufacturers in the Pittsburgh offices, is now public works inspector at the United States naval ammunition depot, Hingham, Mass.

Butler Smith has been transferred from the valuation to the maintenance department of the Northern Pacific Ry. as assistant engineer at Livingston, Montana.

F. S. Small recently resigned his position as Acting District Engineer in charge of the St. John River district of the Canadian Department of Public Works to take a position with Fraser, Brace & Co., who are building an extension to the hydro-electric plant at Cedaro, Quebec.

J. G. Grossman, formerly with the Aberthaw Construction Co., of Boston, is now connected with the Peter Keeler Building Co., of Albany, in which company he has taken a financial interest. At present, Mr. Grossman has charge of the construction of a large church at Fort Edward, New York.

E. S. Needham, who for the past two years has been engineer in charge of the construction of a highway bridge in Santo Domingo, has recently returned to the States.

Battalion and Company Commanders Reserve Engineer Regiments

Sixth Regiment

Col. H. Burgess, Corps of Engineers, commanding.

Lieut. Col. **George H. Webb**, chief engineer, Michigan Central Railroad.

Maj. **John H. Poole**, captain, Corps of Engineers, United States Army. Several years operating mining companies.

Maj. **Sam A. Robertson**, president, San Benito & Rio Grande Valley Railroad of Texas, and president of the San Benito Irrigation Co. Contractor for construction of Southern Pacific Railroad.

Capt. **Raymond F. Fowler**, Corps of Engineers, United States Army, adjutant.

Capt. **Andrew Perry Wenzell**, civil and consulting engineer.

Capt. **Frank B. Weeks**, engineer and contractor. Eight years in United States Volunteers and Artillery Corps, Regular United States Army.

Capt. **H. N. Williams**, superintendent, Chicago division, New York, Chicago & St. Louis Railroad.

Eighth Regiment

Col. **James B. Cavanaugh**, Corps of Engineers, commanding.

Maj. **Joseph W. Williams**, chief engineer of construction for the Northwestern Pacific Railroad Company.

Capt. Adj. **Paul Reisinger**, superintendent and chief engineer of the Arizona & New Mexico Railway Company.

Capt. **Charles C. Cragin**, construction engineer with the firm of Dockweiler & Cragin.

Capt. **Morton Russell**, assistant engineer of the Southern Pacific Company.

Capt. **Bert J. Simmons**, division engineer of the Atchison, Topeka & Santa Fe Railway Company.

J. B. S. Coates has during the past year been engaged as superintendent with the Republic Construction Co., of Mansfield, Ohio, constructing a large power plant for the Mansfield Electric Company.

Brig. Gen. W. L. Sibert, M. Am. Soc. C. E., was named one of the three major-generals in the June 8 order of President Wilson. General Sibert was for many years in the Corps of Engineers and earned notice and promotion to be a brigadier of the line through his work as one of the three division engineers under Colonel Goethals on the Panama Canal.

Col. John Biddle, Corps of Engineers, U. S. A., was named one of the eighteen brigadier generals in the June 8 order of President Wilson. General Biddle was ranked No. 3 in the colonels of engineers and up to a few days before had been superintendent of the Military Academy at West Point. He is one of the best-known officers in the corps whose assignments have extended over a wide field. For a number of years he was Engineer Commissioner of the District of Columbia, where he had charge of the construction of many of the new works, notably the numerous monumental bridges of recent date. During the first part of the European War he was military observer with the armies of the Central Powers.

Thomas Hanley, who has been in charge of the Great Lakes Dredge and Dock Co.'s drill boat No. 4, on the Hudson River rock contract for the Government, has recently been transferred to Philadelphia to take out the Mameluke ledge in the Delaware River between Cramps' shipyard and Petties Island.

George A. Duren, who has recently been appointed state highway engineer of Texas, was resident engineer of the San Antonio & Arkansas Pass Ry. in 1903. In 1904-05 he was designing engineer for the Texas Bridge Co. and since 1908 has been city engineer of Corsicana, Tex. For nearly a year Mr. Duren studied roads and bridges in Germany, France, Belgium and England.

E. E. Oviatt has been promoted to track supervisor, Boston division, New York, New Haven & Hartford Railroad Co., with headquarters at South Braintree, Massachusetts.

William F. Faustman, for several years with the California Highway Commission at Sacramento, Calif., has accepted a position as structural engineer with the Bureau of Yards and Docks, United States Navy Department, at Washington, District of Columbia.

H. T. Whitney has been appointed assistant division engineer of the Michigan division of the Pittsburgh, Cincinnati, Chicago & St. Louis Ry., with headquarters at Logansport, Ind., succeeding E. H. May, transferred.

A. D. Williams, Charleston, W. Va., state engineer, and T. S. Scanlon, former commissioner of Cabell County, have been appointed members of the State Road Commission, created by the recent legislature.

C. E. Hickok, recently with the United States Department of the Interior, has been appointed city engineer and superintendent of streets of Alameda, California.

Charles H. Hurd, member of the Indiana Sanitary Commission, and formerly chief engineer and vice president of the Indianapolis Water Co., has been selected by the War Department as consulting engineer to take charge of the reconstruction of the water-supply and sewage-disposal plants at Fort Benjamin Harrison. The work will involve building at once a new 3,000,000-gal. water-supply system to care for the men expected in September.